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Efficacy of Anterior Tucking vs Conventional Method of Type 1 Tympanoplasty: A Comparative Study

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HIGHLIGHTS

- Comparable graft uptake
- Anterior tucking slightly better
- Hearing outcomes similar
- Most patients improved hearing
- Technique depends on surgeon

Key Words:
Tympanoplasty
Anterior Tucking
Graft Uptake
Hearing Improvement

ABSTRACT

Introduction: Type I tympanoplasty is performed to reconstruct the tympanic membrane and restore middle ear function. Several surgical modifications have been proposed to enhance graft uptake and hearing outcomes, particularly in anterior quadrant and subtotal perforations. This study evaluates the effectiveness of the anterior tucking technique compared with the conventional method. **Aim & Objective:** To compare graft uptake rates and postoperative hearing outcomes between anterior tucking and conventional Type I tympanoplasty in patients with chronic suppurative otitis media (CSOM). **Materials & Methods:** This prospective observational study included 78 patients with CSOM, randomly allocated into two equal groups: Group I (anterior tucking technique, n = 39) and Group II (conventional technique, n = 39). Preoperative and postoperative audiological assessments including air conduction, bone conduction, and air–bone gap (ABG) were performed. Graft status was evaluated using otoendoscopy at 0, 6, and 12 weeks postoperatively. Statistical analysis was conducted using SPSS version 20. **Results:** Both groups were comparable in baseline demographic characteristics. Graft uptake was observed in 100% of patients in the anterior tucking group and 92.3% in the conventional group; however, the difference was not statistically significant ($p = 0.241$). Postoperative hearing improvement, assessed by ABG closure at 6 and 12 weeks, showed no statistically significant difference between the two groups ($p > 0.05$). Overall, 74.36% of patients demonstrated satisfactory hearing improvement, with no significant correlation between graft uptake and degree of hearing gain ($p = 0.156$). **Conclusion:** Anterior tucking and conventional Type I tympanoplasty techniques demonstrate comparable efficacy in terms of graft uptake and hearing outcomes. Surgical technique selection may therefore be guided by surgeon preference and intraoperative anatomical considerations without adversely affecting clinical results.

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INTRODUCTION

Chronic suppurative otitis media (CSOM) is a persistent inflammatory disease of the middle ear and mastoid cavity characterized by tympanic membrane perforation and recurrent otorrhoea. It commonly results from unresolved acute otitis media, Eustachian tube dysfunction, and repeated middle-ear infections, leading primarily to conductive hearing loss and occasionally sensorineural impairment. CSOM disproportionately affects children in low-resource settings where overcrowding, malnutrition, poor hygiene, and limited access to ear-care services are prevalent [1]. Globally, the pooled prevalence of CSOM is estimated at approximately 3.8% (around 297 million individuals), with nearly 85% of cases occurring in low- and middle-income countries [2]. Bilateral disease occurs in about 21.5% of affected individuals, and nearly 62% experience disabling hearing loss (>25–30 dB) [2,3]. In India, prevalence estimates range from 3–5%, placing the country in the high-prevalence category and highlighting ongoing public health concerns [4-6].

Beyond chronic discharge, CSOM significantly impacts speech development, education, and quality of life. Tympanoplasty remains the definitive surgical intervention for persistent perforations, aiming to restore hearing and establish a dry, safe ear [7]. Studies report postoperative hearing improvement in 57–97% of cases, with substantial air–bone gap (ABG) reduction following surgery [8,9]. By reconstructing the tympanic membrane and preserving or restoring ossicular integrity, tympanoplasty prevents recurrent infection and stabilizes middle ear function [10,11].

According to Wullstein's classification, Type I tympanoplasty involves repair of the tympanic membrane with an intact ossicular chain, offering favorable prognosis compared to more advanced types [7,12]. However, anterior quadrant and subtotal perforations pose technical challenges due to limited visualization, reduced graft support, and higher risks of medialization or lateralization [13]. The anterior tucking technique was developed to improve graft stability by securing its anterior margin beneath the annulus or canal wall, thereby enhancing uptake rates [14,15]. Reported graft success rates with anterior tucking approach 95–96%, with meaningful ABG improvement [16,17]. Comparative studies demonstrate similar postoperative hearing gains between anterior tucking and conventional techniques, with no consistent statistically significant differences in ABG closure [18-20]. Nevertheless, anterior tucking may offer anatomical advantages in difficult anterior perforations. **Figure 1**: Illustration of the anterior tucking technique, where the graft is placed beneath the anterior annulus to enhance stability, compared with the conventional method in which the graft is positioned medially without tucking. Both techniques show comparable graft uptake and hearing outcomes.

The present study evaluates the efficacy of anterior tucking compared with the conventional Type I tympanoplasty technique in terms of graft uptake and postoperative hearing improvement, aiming to determine whether this modification provides superior anatomical or functional outcomes.

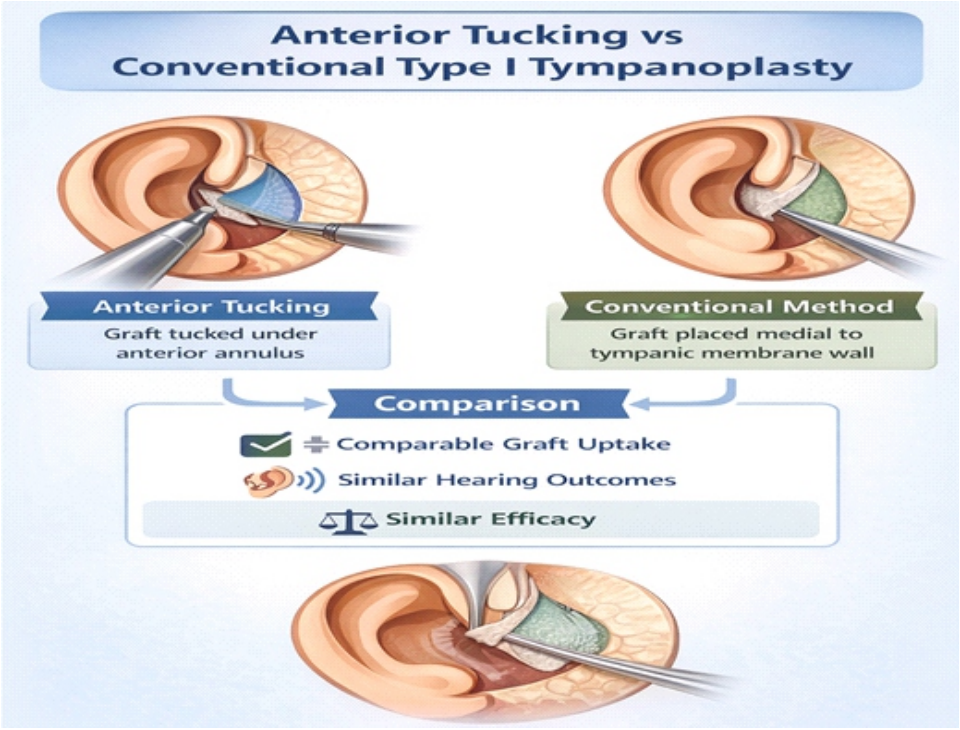

Figure 1: Schematic illustration comparing anterior tucking and conventional underlay techniques of Type I tympanoplasty. Adopted from [32].

MATERIAL & METHODS

This prospective comparative study was conducted at the Department of Otorhinolaryngology, B.L.D.E. (Deemed University) Shri B.M. Patil Medical College, Hospital and Research Center (February 2024-July 2025) to compare anterior tucking and conventional underlay techniques in Type I tympanoplasty. Seventy-eight patients (>12 years) with dry mucosal CSOM and central/anterior or subtotal perforations were included after ethical approval and consent; 39 patients were allocated to each group. All underwent cortical mastoidect-omy with temporalis fascia graft under general anesthesia. In Group 1, the graft's anterior edge was tucked into the anterior sulcus, while in Group 2 it was placed by standard underlay method. Pre- and postoperative assessment included otoscopy and Pure Tone Audiometry with Air-Bone Gap (ABG) evaluation. Follow-up at 2, 6, and 12 weeks assessed graft uptake and hearing improvement. Data were analyzed using SPSS v20.0 with $p<0.05$ considered significant.

RESULTS

Table 1 presents the age- and gender-wise distribution of 78 patients undergoing Type I tympanoplasty to compare the Anterior Tucking and conventional techniques. Females predominated (64.1%) compared to males (35.9%). Most patients were aged 11–30 years, with the highest proportion in the 21–30-year group (26.9%), followed by 11–20 years (25.6%), indicating greater disease prevalence among adolescents and young adults. Females were more common across most age groups, while males were relatively more represented at the extreme age ranges (≤10 and >60 years). A statistically significant association between age and gender was observed ($\chi^2 = 12.67$, $p = 0.048$) (Table 1). **Table 2** shows the residence distribution of patients, with a clear predominance from rural areas (79.49%) compared to urban areas (20.51%). This unequal distribution was highly statistically significant ($\chi^2 = 32.05$, $p < 0.0001$). **Figure 2:** Intra-operative view showing anterior tucking during underlay tympanoplasty, with graft placed medial to the tympanic membrane and its anterior edge tucked under the annulus for stability and better graft uptake.

Figure 3: Intra-operative view showing the conventional underlay tympanoplasty technique, with the graft placed medial to the tympanic membrane remnant without anterior tucking. The occupational profile of patients undergoing Type I tympanoplasty. Students formed the largest group (35.9%), followed by housewives (24.36%), private employees (19.23%), and farmers (12.82%), with teachers and labourers comprising smaller proportions. The distribution showed a highly significant deviation from equality ($\chi^2 = 43.27$, $p < 0.0001$). The predominance of economically dependent or semi-dependent groups highlights the socioeconomic burden of disease. As both surgical techniques were applied across a similar occupational spectrum spectrum, occupational status was unlikely to influence graft uptake or hearing outcomes, thereby supporting the study's internal validity (**Figure 4**). The study population predominantly comprised Hindus (85.9%), with Muslims accounting for 14.1% of the 78 patients. This distribution showed a highly significant deviation from equality ($\chi^2 = 40.21$, $p < 0.0001$). Patients from both religious groups were managed using identical clinical protocols and were represented in both surgical groups, minimizing selection bias. Therefore, postoperative outcomes can be attributed to the surgical technique rather than religious or sociocultural factors (**Figure 5**). Among the 78 patients undergoing Type I tympanoplasty, 42 (53.85%) had left-sided and 36 (46.15%) had right-sided perforations. This distribution showed no significant difference ($\chi^2 = 0.46$, $p = 0.49$), indicating comparable involvement of both ears. Laterality was evenly represented across surgical groups, making it unlikely to confound outcomes (**Figure 6**). Among the 78 patients, the most common presenting symptom was ear discharge with hearing loss in 50 patients (64%), followed by ear discharge alone (22%), hearing loss alone (9%), and earache (5%). This distribution was highly significant ($\chi^2 = 68.65$, $p < 0.0001$), reflecting the chronic and combined nature of disease in most patients. Comparable symptom profiles across surgical groups ensure that postoperative outcomes can be reliably attributed to the Anterior Tucking or Conventional technique rather than baseline differences (**Figure 7**). Among the 78 patients, Large Central perforations were most common (41%), followed by Subtotal (23%) and Small Central (14%), with Anterior Quadrant (13%), Posterior Quadrant (6%), and Marginal (3%) less frequent ($\chi^2 = 44.92$, $p < 0.00001$). Both surgical groups had a similar perforation-type distribution, ensuring that differences in graft uptake or hearing outcomes reflect the technique rather than baseline disease severity (**Figure 8**). In this cohort, the vast majority of patients (96%) had no family history of similar ear disease, with only 4% reporting such history ($\chi^2 = 66.46$, $p < 0.0001$). This indicates that hereditary factors are minimal, ensuring that differences in graft uptake and hearing outcomes between Anterior Tucking and Conventional techniques primarily reflect surgical efficacy rather than genetic predisposition (**Figure 9**). The distribution of presenting illness showed significant variability ($\chi^2 = 57.67$, $p < 0.0001$), with the most common being ear discharge for one year (23%) and other chronic symptoms like combined discharge and hearing loss. This pattern reflects typical chronic otitis media. Comparable chronicity across both surgical groups ensures that postoperative graft uptake and hearing outcomes reflect the surgical technique rather than differences in disease duration or severity (**Table 3**). **Table 4** shows significant variation in patients' past medical history ($\chi^2 = 39.54$, $p < 0.0001$). Most (55%) had no significant history, while 19% had prior antibiotic use, 17% recurrent URTIs, and 9% allergies. This indicates that chronic otitis media

in the cohort is largely influenced by environmental or infectious factors rather than underlying comorbidities. Similar distributions across both surgical groups ensure that differences in tympanoplasty outcomes reflect the surgical technique rather than baseline health status. **Table 5** summarizes baseline clinical parameters, showing that vital signs, hematologic indices, renal function, and coagulation profiles were within normal ranges. This confirms that patients were systemically healthy and fit for surgery, ensuring that postoperative outcomes-graft uptake and hearing improvement-reflect the effects of the surgical techniques rather than underlying health conditions. Systemic and middle ear assessments, showing that most patients had normal chest X-rays, ECGs, and negative viral screenings (HIV, HBsAg, HCV), while mastoid X-rays were predominantly normal. These findings confirm that the cohort was clinically stable and suitable for tympanoplasty, ensuring that postoperative outcomes-graft uptake and hearing improvement-reflect the surgical technique rather than underlying systemic disease, with similar baseline profiles across both Anterior Tucking and Conventional groups (**Figure 10)**. Baseline audiometric assessment showed comparable preoperative hearing in both groups, with no significant differences in Air Conduction (AC), Bone Conduction (BC), or Air–Bone Gap (ABG) (AC $p = 0.76$, BC $p = 0.40$, ABG $p = 0.25$). This equivalence confirms that both groups started with similar conductive deficits, ensuring that postoperative hearing improvements reflect the surgical technique rather than baseline variability (**Table 6**). Postoperative audiometry at 6 and 12 weeks showed no significant differences between groups in Air Conduction (AC), Bone Conduction (BC), or Air–Bone Gap (ABG) (6 wk: AC $p = 0.35$, BC $p = 0.69$, ABG $p = 0.27$; 12 wk: AC $p = 0.51$, BC $p = 0.72$, ABG $p = 0.66$). With comparable preoperative hearing, these results indicate that both Anterior Tucking and Conventional techniques are equally effective in restoring auditory function during early and intermediate recovery, supporting their clinical equivalence in improving postoperative hearing (**Table 7**). **Figure 11** highlights graft uptake, a key measure of tympanoplasty success. In the Anterior Tucking group, all 39 patients (100%) achieved graft integration, while the Conventional group had 36 of 39 successes (92.3%). Fisher's Exact Test yielded $p = 0.241$, indicating no statistically significant difference. These results confirm that both techniques are highly effective, with success rates above 90%, and that either method provides reliable tympanic membrane reconstruction despite the numerically perfect outcome seen with anterior tucking. **Figure 12** compares graft uptake between the Anterior Tucking (Group 1) and Conventional (Group 2) techniques.Group 1 achieved 100% success (39/39), while Group 2 had 92.3% success (36/39). Fisher's Exact Test yielded $p = 0.241$, indicating no statistically significant difference. Although the Anterior Tucking group shows a numerical advantage and an odds ratio of 5.42 suggests a higher likelihood of failure in the Conventional group, this trend is not statistically conclusive. Overall, both techniques are comparably effective in achieving anatomical success. **Figure 13** compares patients by perforation type-anterior quadrant, large central, and subtotal with dry mucosa-across surgical groups. Chi-square analysis showed no significant association between technique and perforation type ($\chi^2 = 1.11$, $p = 0.573$). Each perforation category was similarly distributed in both groups, indicating that neither group was biased by more complex or favorable perforations. **Figure 14** compares preoperative otoendoscopic findings between the two groups, providing essential clinical context. Chi-square analysis showed no significant difference ($\chi^2 = 0.37$, $p = 0.544$), with central perforations and a dry middle ear predominating in both groups (31 in Group 1, 29 in Group 2) and attic perforations similarly distributed. This baseline uniformity ensures that postoperative outcomes, including graft uptake and hearing improvement, can be attributed to surgical technique rather than differences in anatomical or disease-related factors. **Figure 15** compares postoperative otoendoscopic findings between the two groups, assessing graft integrity and middle ear healing. Chi-square analysis showed no significant difference ($\chi^2 = 1.17$, $p = 0.279$), with normal findings in 36/39 patients in Group 1 and 33/39 in Group 2. Residual perforations were slightly higher in Group 2 (6 vs. 3), but not statistically significant. These results indicate that both surgical techniques are equally effective in promoting tympanic membrane healing, supporting the comparable graft uptake and postoperative hearing outcomes observed in the study. **Figure 16** summarizes preoperative otological findings for both ears in the two groups, covering external ear, middle ear, vestibular, and tuning fork test parameters. Both groups showed largely similar distributions across all major assessments, including pinna, peri-auricular regions, external auditory canal, and tympanic membrane status. Signs of severe disease-mastoid tenderness, fistula, tragal tenderness, facial nerve weakness, or spontaneous nystagmus were rare and evenly distributed. Tuning fork tests (Rinne, Weber, and Absolute Bone Conduction) also demonstrated comparable patterns. This clinical homogeneity confirms that both groups were baseline-matched, ensuring that postoperative differences in graft uptake or hearing outcomes reflect the surgical technique rather than preexisting anatomical or clinical disparities. **Figure 17** summarizes postoperative hearing outcomes, showing that 58 of 78 patients (74.36%) achieved good improvement, while 20 (25.64%) had moderate improvement. Chi-square analysis confirmed this distribution was highly significant ($\chi^2 = 18.51$, $p < 0.0001$), indicating that good hearing recovery predominated. These results demonstrate that tympanoplasty regardless of technique is generally effective in restoring auditory function in chronic otitis media with tymp-

anic membrane perforation. **Figure 18** examines the relationship between graft success and hearing outcomes. Among 75 patients with successful graft uptake, 57 (76%) had good hearing improvement, while 18 (24%) showed moderate improvement. Of the three graft failures, only one had good improvement and two had moderate. Fisher's Exact Test yielded a non-significant p-value (0.156), though the odds ratio (6.33) suggests a trend toward better hearing with successful grafts.

These findings indicate that while graft uptake generally supports functional improvement, other factors like ossicular integrity and middle ear status may also influence hearing outcomes. **Figure 19** likely depicts the preoperative otoendoscopic view of a patient's tympanic membrane, illustrating the specific pathology prior to tympanoplasty. **Figure 20** likely shows the postoperative otoendoscopic view of the same patient's tympanic membrane at 12 weeks following tympanoplasty.

Table 1: Age and gender-wise distribution of patients

Age Group	Female	Male	Total
0–10	0	3	3
11–20	15	5	20
21–30	12	9	21
31–40	11	2	13
41–50	9	5	14
51–60	3	2	5
>60	0	2	2
Total	50	28	78
Total %	64.10	35.90	100.00
Chi (χ^2)-12.67, p-value-0.048			

Table 2: Residence of Patients

Residence	Number of patients	Total %
Rural	62	79.49
Urban	16	20.51
Total %	78	100
Chi (χ^2)-32.05, **p-value**-<0.0001		

Table 3: History of Presenting Illness

History of Presenting Illness	Count	Total %
Ear discharge for 1 year	18	23.08
Ear discharge for 6 months	11	14.10
Ear discharge & hearing loss for 1 year	10	12.82
Ear discharge & hearing loss for 2 years	6	7.69
Ear discharge & hearing loss for >2 years	5	6.41
Earache for 2 years	3	3.85
Ear discharge for 2 months	2	2.56
Ear discharge for >2 years	2	2.56
Ear discharge & hearing loss for 6 months	2	2.56
Earache for 1 year	1	1.28
Tinnitus for 1 year	1	1.28
Reduced hearing for >2 years	1	1.28
Ear discharge & hearing loss for 2 months	1	1.28
Chi (χ^2)-57.67, **p-value**-<0.0001		

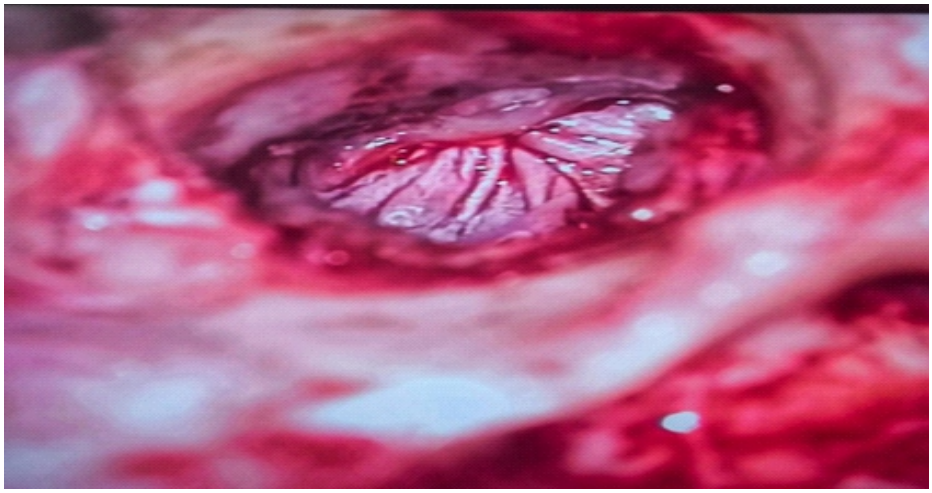

Figure 2: Intra-operative view demonstrating the anterior tucking technique during underlay tympanoplasty

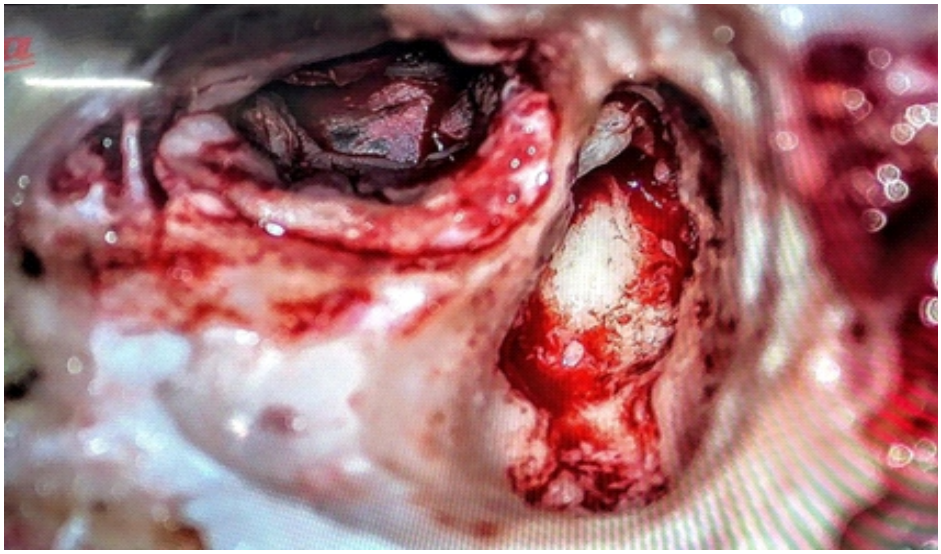

Figure 3: Intra-operative view demonstrating the conventional underlay technique of tympanoplasty

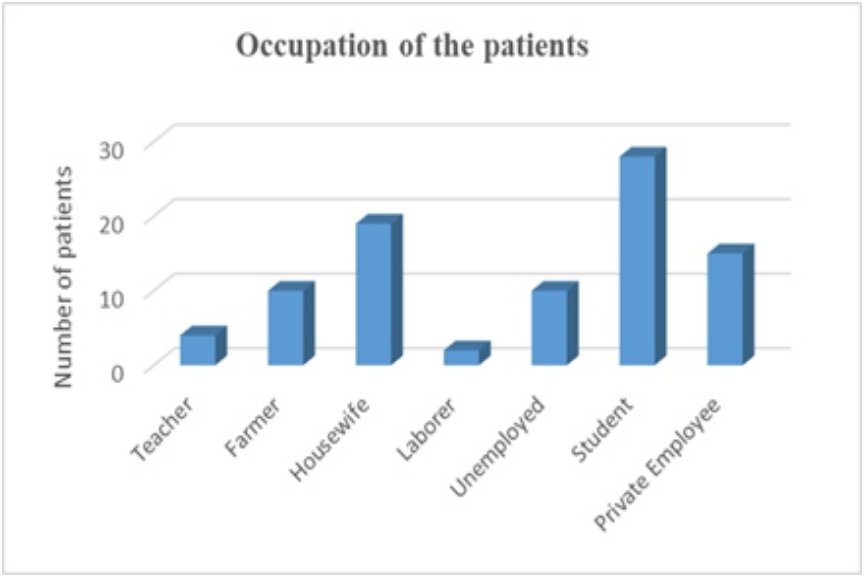

Figure 4: Occupation of patients

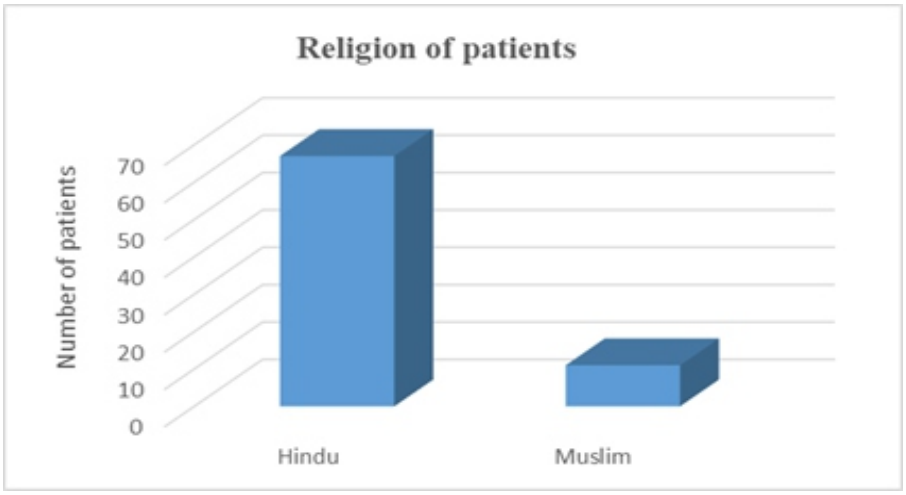

Figure 5: Religion of patients

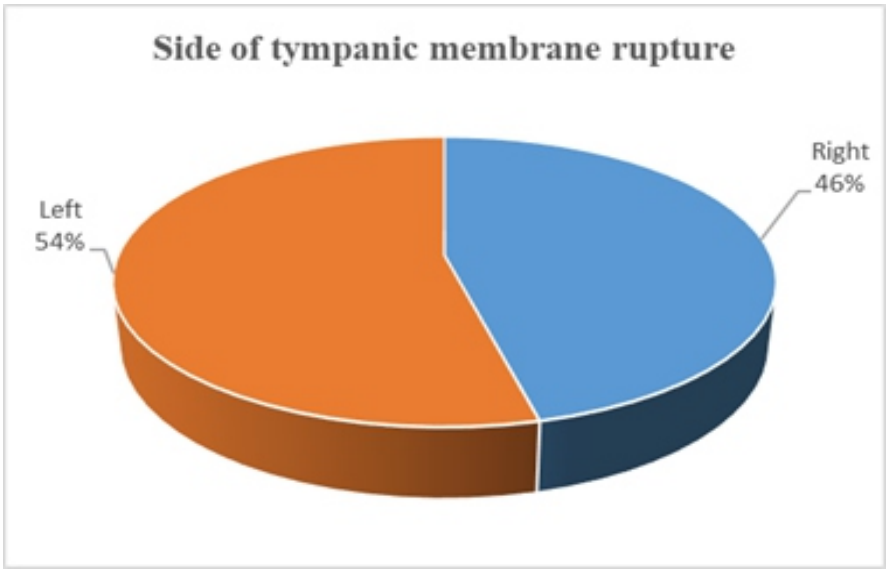

Figure 6: Side of tympanic membrane rupture

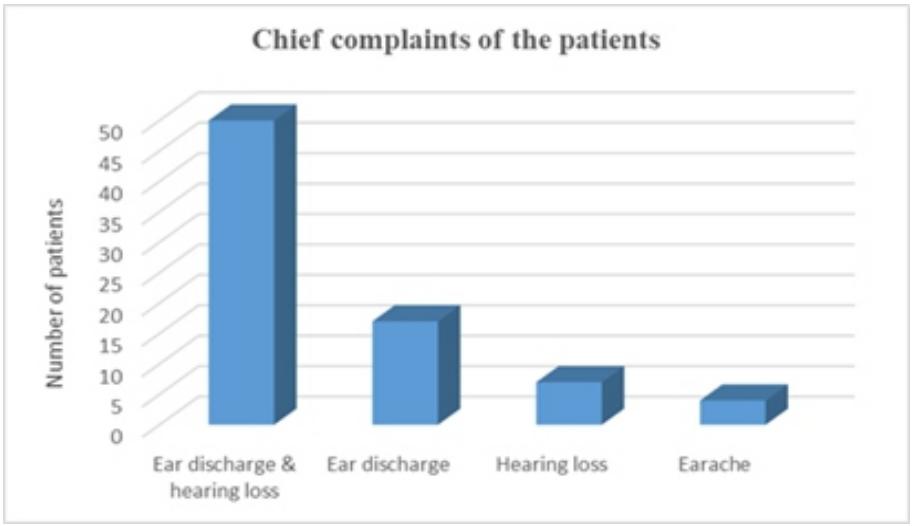

Figure 7: Chief complaints of patients

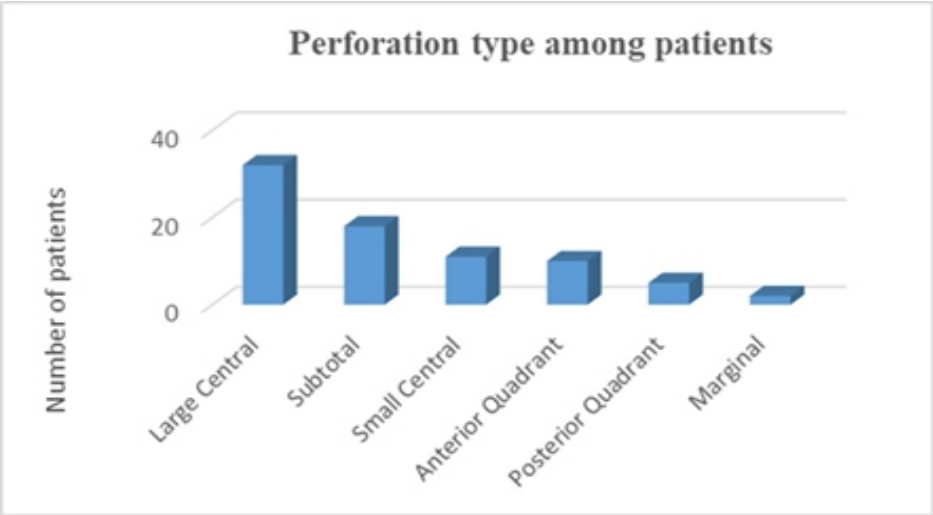

Figure 8: Type of perforation

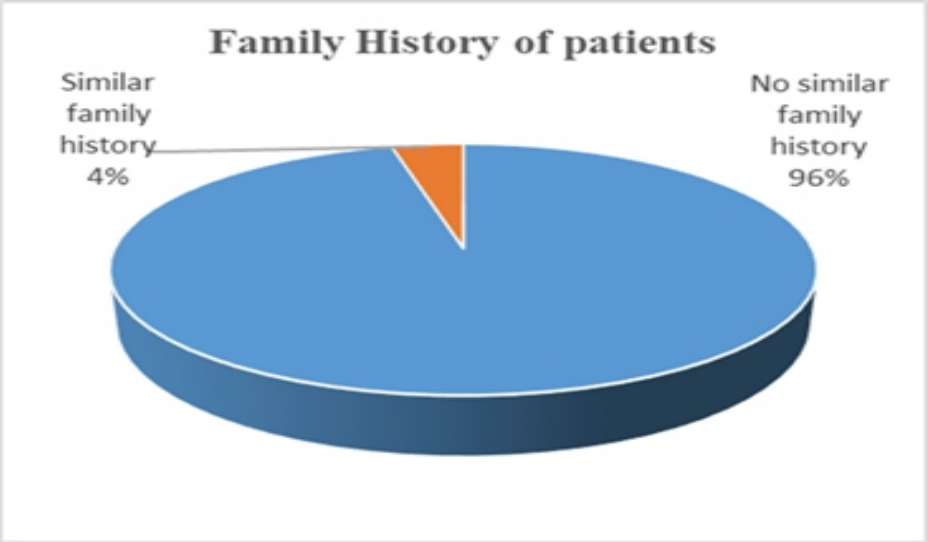

Figure 9: Family History of patients

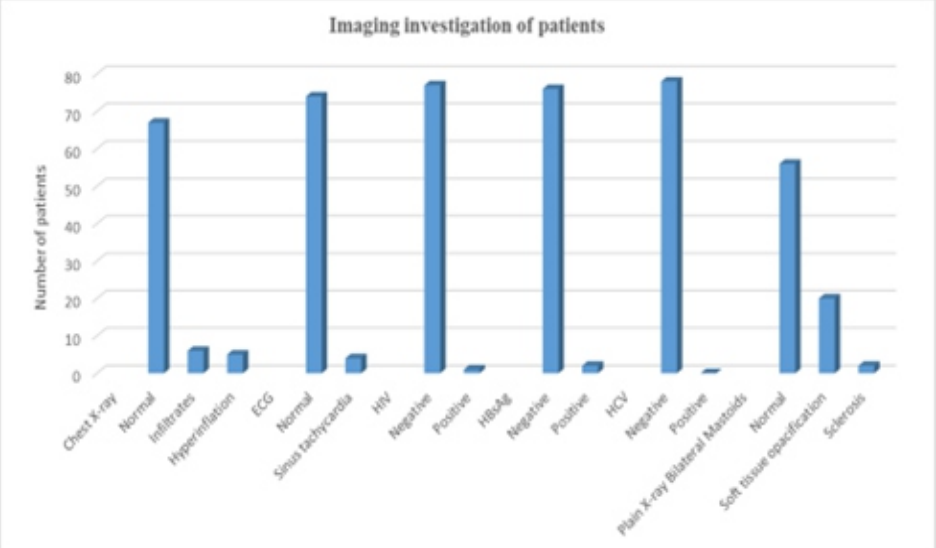

Figure 10: Imaging and biological investigations in patients

Table 4: Past History of infection or allergy

Past History	Count	Total %
No significant past history	43	55.13
Previous antibiotic treatment	15	19.23
Recurrent URTI	13	16.67
History of allergy	7	8.97
Chi (χ^2)-39.54, **p-value** -<0.0001		

Table 5: Clinical investigations in patients

Parameter	Mean	SD
Systolic BP (mmHg)	118.68	11.1
Diastolic BP (mmHg)	76.31	9.53
Pulse Rate (bpm)	78.46	12.53
Respiratory Rate (/min)	16.29	3.05
Temperature (°C)	36.56	0.29
Hemoglobin (Hb g/dL)	13.12	1.17
WBC (×10³/µL)	7.18	1.82
Platelet Count (×10³/µL)	257.58	68.06
RBS (mg/dL)	100.47	14.86
Blood Urea (mg/dL)	27.65	7.37
Serum Creatinine (mg/dL)	0.91	0.17
Bleeding Time (minutes)	2.48	0.64
Clotting Time (minutes)	6.71	0.8

Table 6: Comparison of Preoperative Air Conduction (AC), Bone Conduction (BC), and Air–Bone Gap (ABG) Between Group 1 and Group 2

Parameter	Group 1 (Anterior Tucking)	Group 2 (Conventional)	t-test	p-value
AC (dB)	34.53 ± 7.53	35.05 ± 7.30	-0.31	0.76
BC (dB)	12.02 ± 2.26	11.62 ± 1.97	0.83	0.40
ABG (dB)	21.17 ± 4.24	22.21 ± 3.73	-1.15	0.25

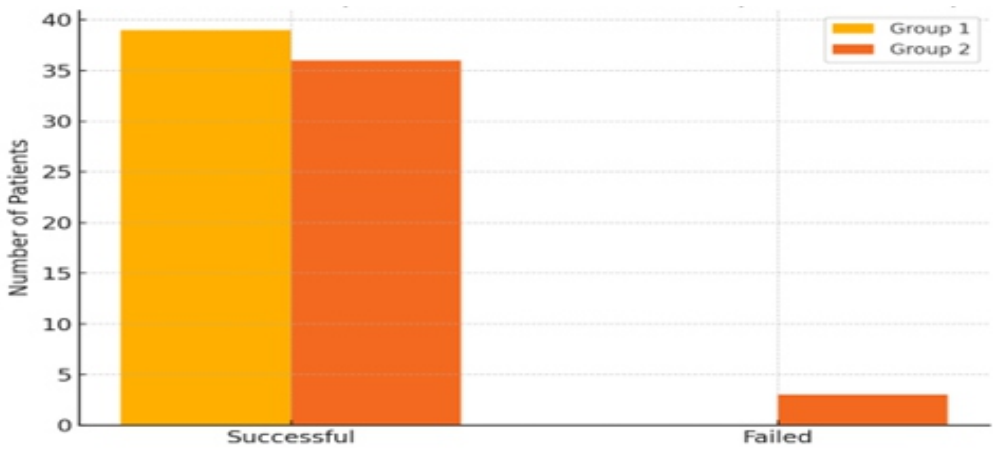

Figure 11: Comparison of Graft Uptake Outcomes Between Group 1 and Group 2

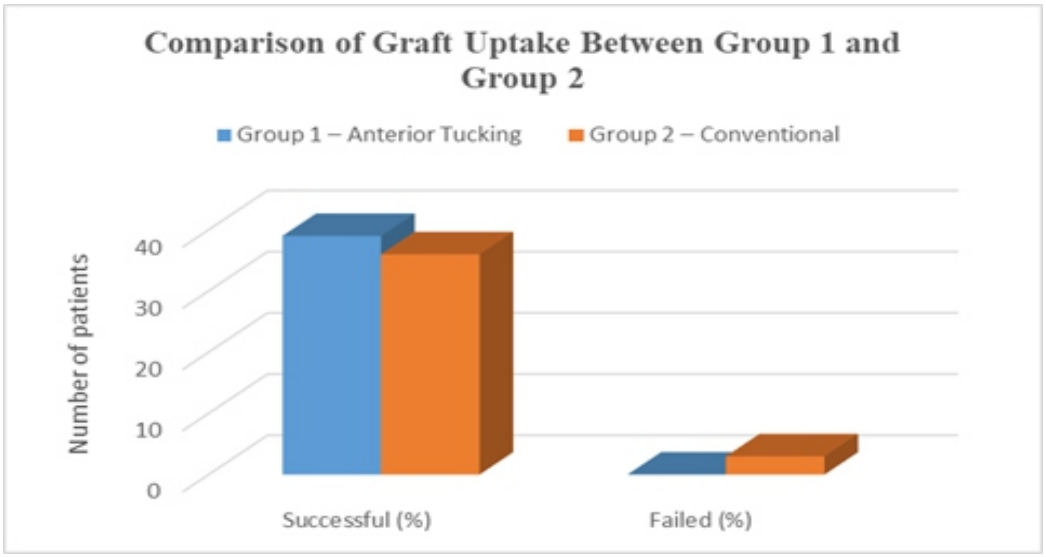

Figure 12: Comparison of Graft Uptake Between Group 1 and Group 2

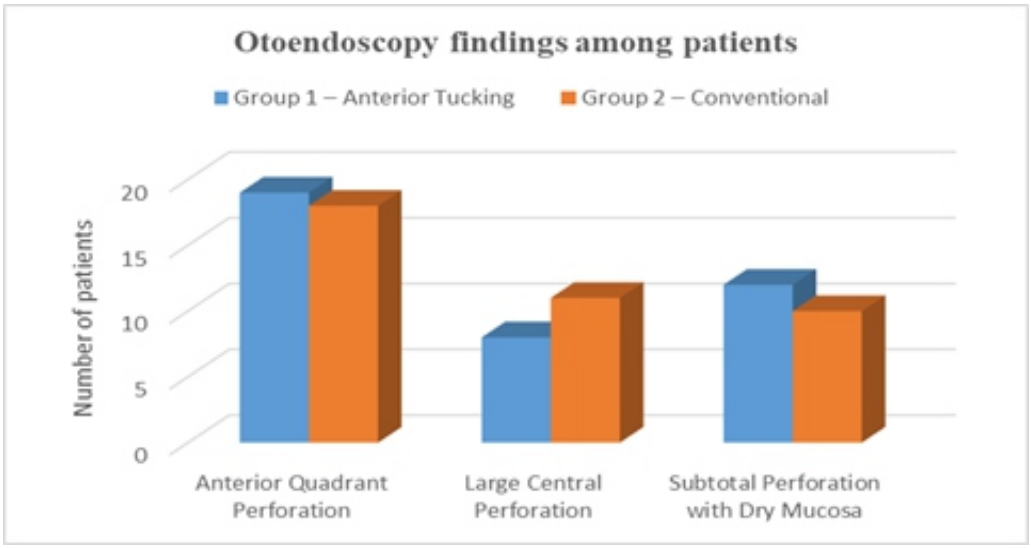

Figure 13: Otoendoscopy findings of patients in group 1 and 2

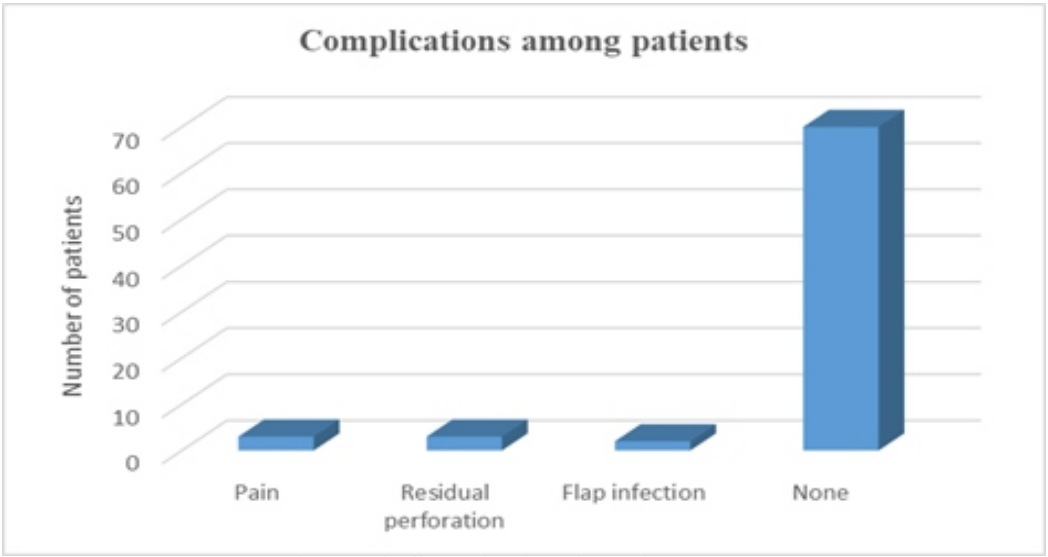

Figure 14: Complications in patients

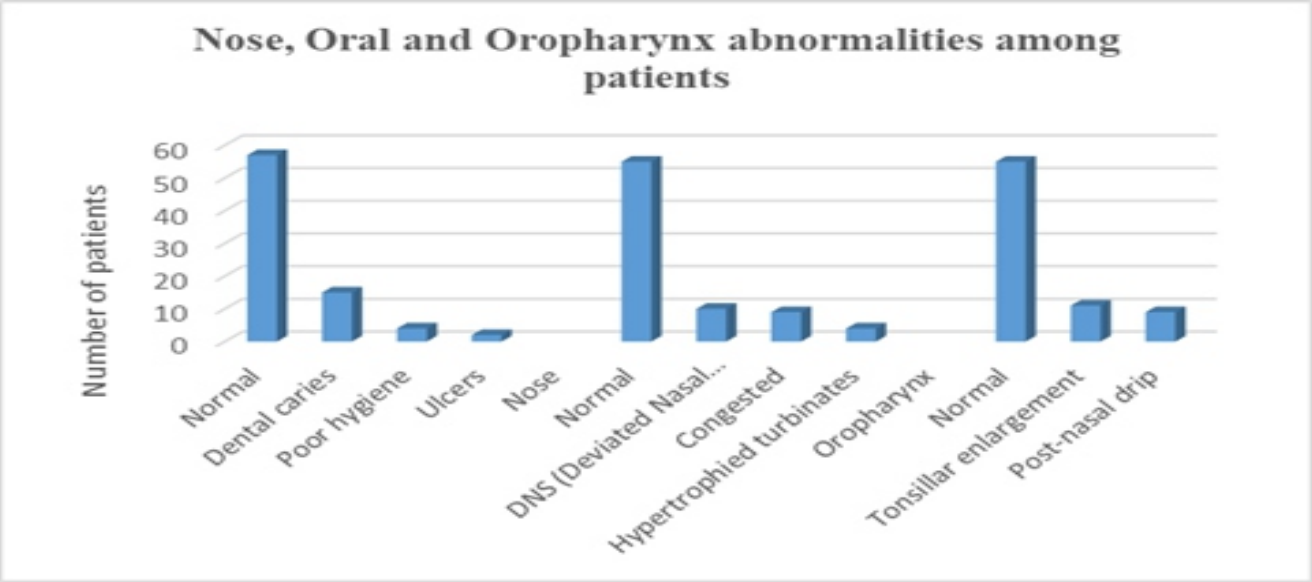

Figure 15: Complications in the Nose, oral cavity and Oropharynx

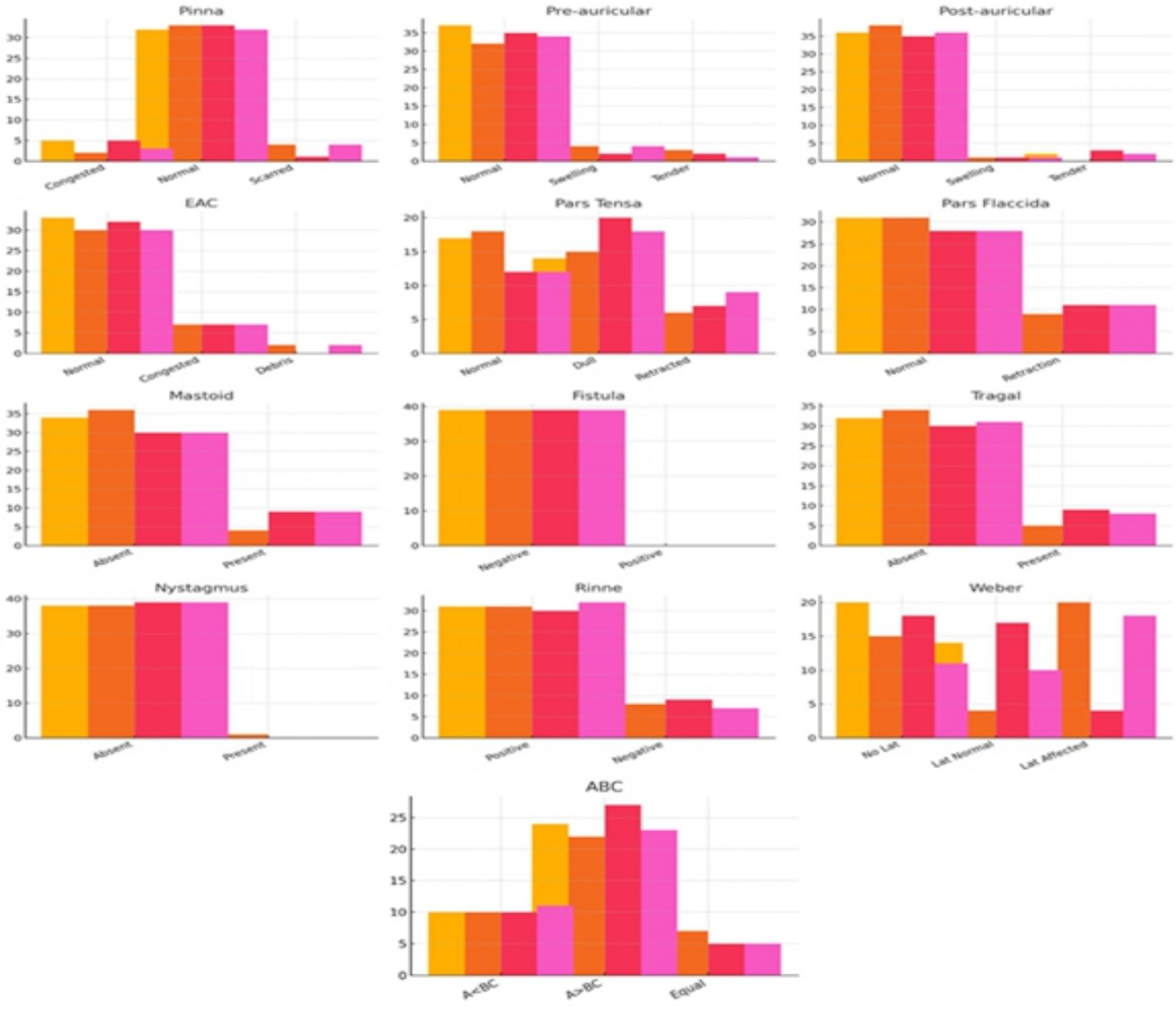

Figure 16: Ontological examination findings for both ears in the two study groups

Table 7: Comparison of Post-operative Air Conduction (AC), Bone Conduction (BC), and Air–Bone Gap (ABG) Between Group 1 and Group 2

Parameter	Group 1 (Anterior Tucking)	Group 2 (Conventional)	t-test	p-value
Post-op AC (6 weeks)	23.32 ± 5.17	24.40 ± 5.03	-0.940	0.35
Post-op BC (6 weeks)	11.80 ± 2.11	11.61 ± 2.14	0.39	0.69
Post-op ABG (6 weeks)	11.52 ± 5.28	12.79 ± 4.79	-1.11	0.27
Post-op AC (12 weeks)	23.65 ± 5.45	24.43 ± 5.12	-0.650	0.51
Post-op BC (12 weeks)	11.59 ± 2.56	11.80 ± 2.61	-0.36	0.72
Post-op ABG (12 weeks)	12.05 ± 5.65	12.63 ± 5.91	-0.44	0.66

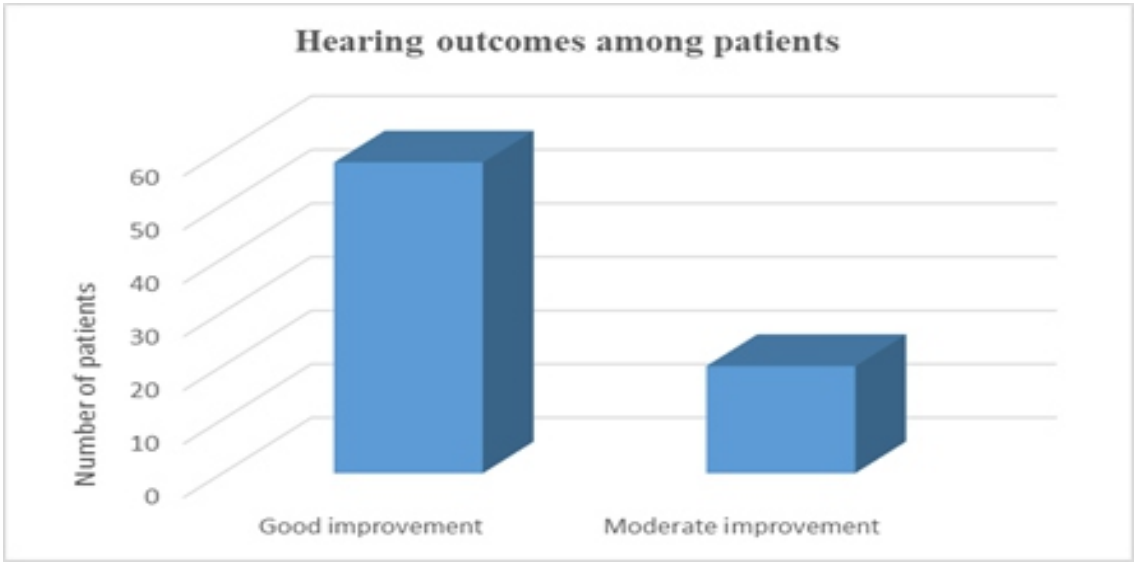

Figure 17: Hearing outcomes among patients

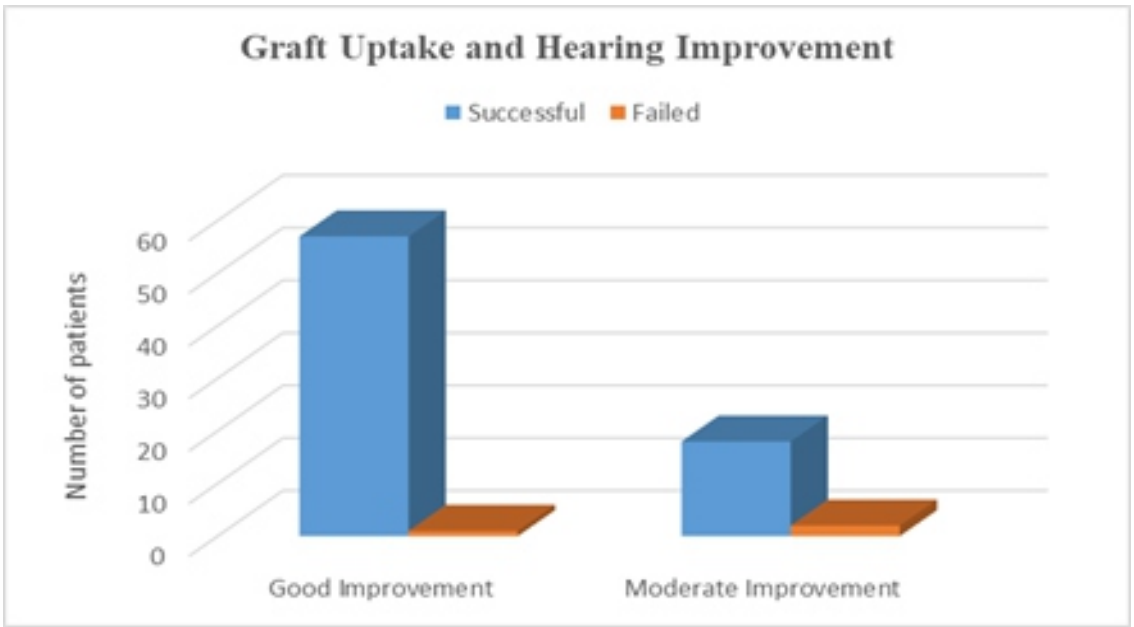

Figure 18: Graft Uptake and Hearing outcomes among patients

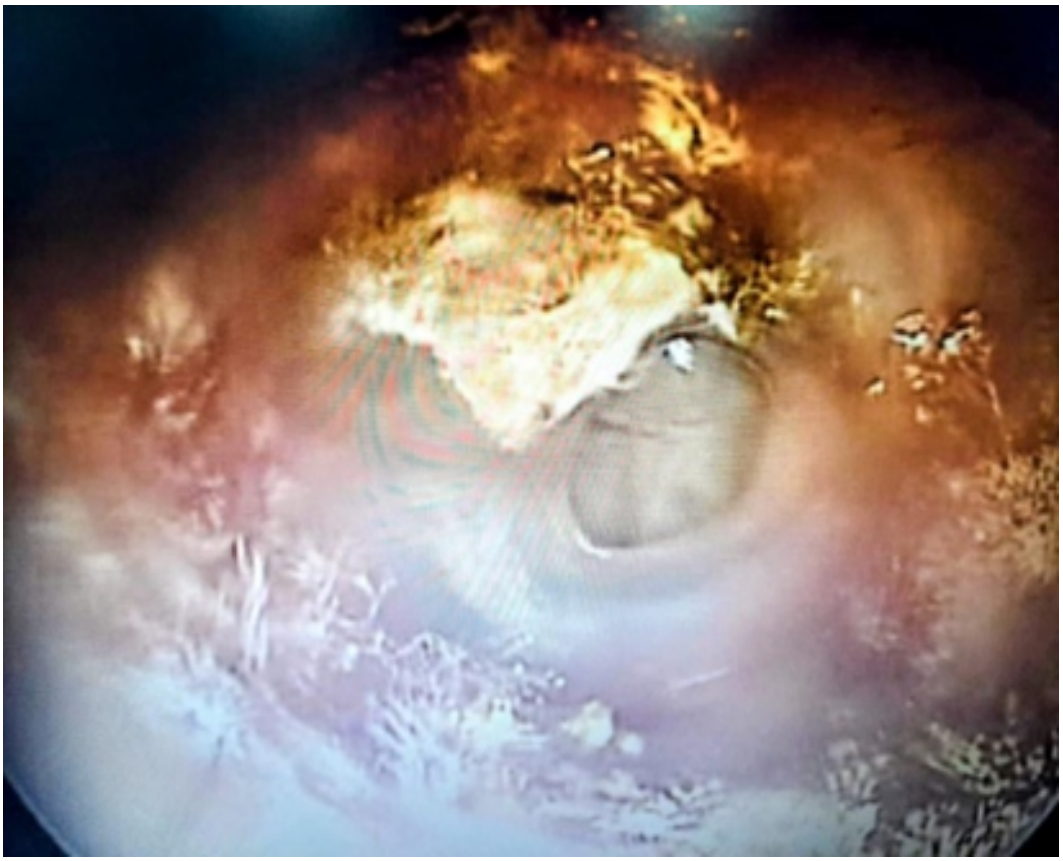

Figure 19: Pre-Operative Oto-Endoscopy of a Patient

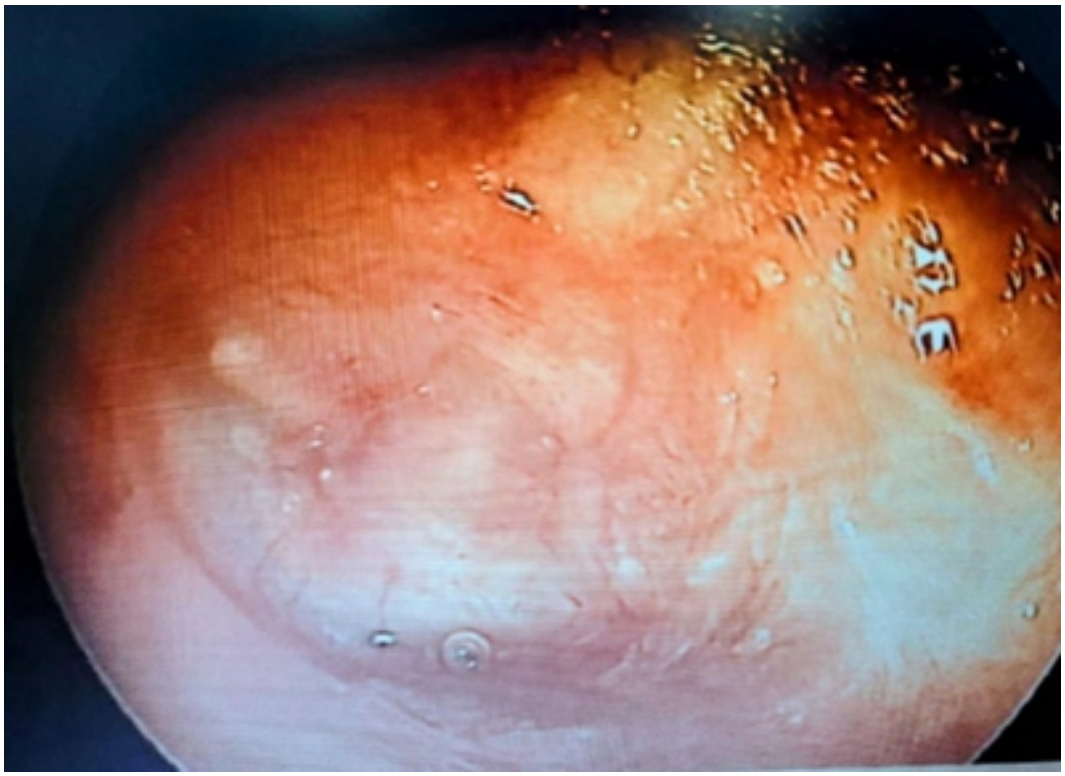

Figure 20: Post-Operative Oto-Endoscopy of same Patient at 12 weeks

DISCUSSION

Type I tympanoplasty, as originally conceptualized under Horst Ludwig Wullstein's classification, is performed to repair tympanic membrane perforations with an intact ossicular chain, aiming to restore membrane integrity and improve conductive hearing [21]. Chronic suppurative otitis media (CSOM) and traumatic perforations remain the leading indications, particularly in developing regions where recurrent infections and delayed treatment are common [22]. Although the conven-tional underlay technique is widely practiced because of its technical simplicity and reliable outcomes, anterior quadrant perforations continue to pose surgical challenges due to limited visualization, anterior canal wall overhang, and inadequate graft support, which may predispose to graft medialization or residual perforation [23]. To address these limitations, anterior tucking has been advocated as a modification in which the graft edge is secured beneath the anterior annulus or canal wall, thereby enhancing stability and anterior graft uptake without significantly increasing operative complexity [24,25]. Evaluating whether this modification translates into superior anatomical or functional outcomes remains clinically relevant [26].

In the present study of 78 patients, demographic analysis showed female predominance (64.10%) with a significant association between age and gender ($p = 0.048$). Similar female predominance and clustering in young adult age groups have been reported in comparative tympanoplasty studies, suggesting that our cohort profile aligns with broader surgical populations [26,27]. Rural patients constituted 79.49% of our sample ($p < 0.0001$), reflecting healthcare access patterns in our region; other Indian series also report substantial rural representation in tympanoplasty cohorts, though not always statistically analyzed [26,27]. Occupational distribution showed students and housewives forming the largest groups, highlighting the socioeconomic diversity of patients undergoing surgery. Religion distribution reflected regional demographics and, while statistically significant, has not been routinely reported in comparable surgical literature, underscoring the value of contextual demographic documentation [28].

Clinically, left-sided perforations were slightly more frequent but not statistically significant, consistent with the general assumption of symmetrical laterality in tympanoplasty studies [29,31]. The predominant presenting complaint was combined ear discharge and hearing loss (64.10%), in agreement with established descriptions of CSOM symptomatology [30]. Large central (41.03%) and subtotal (23.08%) perforations were most common, paralleling other anterior tucking studies that preferentially include extensive perforations because of their higher risk of graft failure [29]. Family history was uncommon (3.85%), suggesting minimal hereditary confounding. Past histories of recurrent infection or allergy were present in a minority, and most patients were systemically fit, with normal hematologic, biochemical, radiologic, and serologic parameters, consistent with inclusion of inactive mucosal CSOM cases as in other comparative studies [30].

Preoperative audiological parameters were comparable between groups, with no significant differences in air conduction, bone conduction, or air–bone gap (ABG), mirroring baseline equivalence reported in other anterior tucking comparisons [30]. Postoperatively, both techniques demons-trated significant hearing improvement at 6 and 12 weeks, with no statistically significant intergroup differences in AC, BC, or ABG ($p > 0.05$). Similar findings have been documented in prior prospective comparisons, where anterior tucking yielded slightly higher numerical gains but without statistical superiority [8,13]. Thus, our data reinforce the conclusion that anterior tucking and conventional underlay techniques provide comparable functional hearing outcomes.

Regarding graft uptake, anterior tucking achieved 100% success compared to 92.3% in the conventional group, though the difference was not statistically significant ($p = 0.241$). Comparable studies report graft uptake rates of approximately 93–97% with anterior tucking and 84–90% with conventional methods, often without significant statistical difference, suggesting a consistent trend toward marginal anatomical advantage without definitive superiority [7,11]. Otoendoscopic evaluation confirmed balanced perforation characteristics between groups, supporting the internal validity of outcome comparison. Postoperative complications were minimal and comparable between techniques, limited to minor pain, infection, or residual perforation, aligning with low complication profiles reported in the literature [8,11]. Associated nasal and nasopharyngeal findings were documented, acknowledging evidence that Eustachian tube function influences tympanoplasty success [14].

Overall hearing outcomes were favorable, with 74.36% achieving good improvement and 25.64% moderate improvement, comparable to other Type I tympanoplasty series reporting postoperative ABG ≤20 dB in approximately three-quarters of patients [15,7]. Combined analysis of graft uptake and hearing demonstrated a 93% overall success rate, with healed grafts consistently associated with meaningful ABG closure. Similar correlations between anatomical success and functional improvement have been documented in comparative anterior tucking research [7,11].

In summary, our findings demonstrate that both anterior tucking and conventional Type I tympanoplasty provide high graft uptake rates and significant hearing improvement in patients with mucosal CSOM. Although anterior tucking showed a slight numerical advantage in graft integration, the difference was not statistically significant, and postoperative audiological outcomes were comparable. These results support the view that anter-

ior tucking is a safe and effective modification particularly suited for large or anterior perforations, while conventional underlay tympanoplasty remains equally reliable when performed meticulously. Overall, surgical expertise, middle-ear status, and patient factors appear to influence outcomes more than the specific graft placement modification alone, consistent with contemporary tympanoplasty literature [7,11,26].

CONCLUSION

In conclusion, this prospective comparative study demonstrates that both the Anterior Tucking and Conventional Underlay techniques of Type I Tympanoplasty are highly effective for the management of tympanic membrane perforations in inactive mucosal CSOM, yielding statistically comparable and clinically significant postoperative hearing improvement. While both methods achieved excellent functional outcomes, the Anterior Tucking technique showed a clinically meaningful trend toward superior anatomical success, with a 100% graft uptake compared to 92.3% in the Conventional group, although this difference did not reach statistical significance. The enhanced anterior graft stabilization achieved by tucking into the bony sulcus likely contributes to improved graft security, particularly in cases with compromised anterior margins. Therefore, although the Conventional underlay technique remains a reliable gold-standard procedure, the Anterior Tucking method represents a valuable technical refinement, especially for challenging anterior and large perforations. Mastery of this maneuver may enhance surgical predictability and anatomical closure rates, reinforcing the importance of technique-specific modifications tailored to anatomical demands in achieving optimal otological outcomes.

LIMITATIONS & FUTURE PERSPECTIVES

The study was limited by its single-centre design, relatively small sample size, and short duration, which may restrict generalizability. Future research could focus on multicenter studies with larger cohorts to validate findings, evaluate long-term outcomes, and explore innovative diagnostic and management strategies for appendicular perforation, improving patient prognosis and reducing complications.

CLINICAL SIGNIFICANCE

Timely detection and management of acute appendicitis are crucial to prevent perforation, reducing morbidity and mortality. The study identifies high-risk groups, such as males and individuals at age extremes, highlighting the need for targeted preventive strategies and clinical vigilance. Delayed presentation significantly increases perforation risk, underscoring the importance of early healthcare access and awareness campaigns. Postoperative complications, including surgical site infections and prolonged ileus, emphasize the need for thorough preoperative risk assessment and tailored postoperative care. Recognizing the distal third of the appendix as the most common perforation site aids surgeons in effective intraoperative planning and management.

ABBREVIATIONS

AT: Anterior tucking
CT: Conventional technique
GU: Graft uptake
HO: Hearing outcomes
CSOM: Chronic suppurative otitis media

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All authors significantly contributed to the study conception and design, data acquisition, or data analysis and interpretation. They participated in drafting the manuscript or critically revising it for important intellectual content, consented to its submission to the current journal, provided final approval for the version to be published, and accepted responsibility for all aspects of the work. Additionally, all authors meet the authorship criteriaoutlined by the International Committee of Medical Journal Editors (ICMJE) guidelines.

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CONFLICT OF INTEREST

Authors declared that there is no conflict of interest.

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The authors confirm that no AI & LLM tools were used in the writing or editing of the manuscript, and no images were altered or manipulated using AI & LLM.

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This article serves as an important educational tool for the scientific community, offering insights that may inspire future research directions. However, they should not be relied upon independently when making treatment decisions or developing public health policies.

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