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Original Research Article

Assessment of Efficacy of Chemical Cauterisation Versus Fat Plug Myringoplasty in Closing Small Central Tympanic Membrane Perforations: A Prospective Interventional Study

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Conflict of interest: Nil

Abstract

Background: Tympanic membrane (TM) perforation is a common otological condition often associated with conductive hearing loss and recurrent infections. Minimally invasive techniques such as chemical cauterisation and fat plug myringoplasty have gained popularity for the management of small central perforations due to their simplicity and cost-effectiveness.

Aim: To compare the efficacy of chemical cauterisation and fat plug myringoplasty in the closure of small central tympanic membrane perforations with respect to anatomical closure, hearing improvement, complications, and patient satisfaction.

Materials and Methods: This prospective, randomized interventional study was conducted in the Department of Otorhinolaryngology at ESIC Medical College & Hospital, Bihta, Patna, India. A total of 100 patients with small central tympanic membrane perforations were enrolled and randomly divided into two groups: Group I (chemical cauterisation) and Group II (fat plug myringoplasty), with 50 patients in each group. Patients were evaluated using otoscopic examination and Pure Tone Audiometry (PTA) preoperatively and at 3 months post-procedure. Outcomes assessed included closure rate, PTA improvement, postoperative complications, and patient satisfaction. Statistical analysis was performed using SPSS version 27.0, with $p < 0.05$ considered statistically significant.

Results: Baseline characteristics were comparable between the two groups ($p > 0.05$). The closure success rate was significantly higher in the fat plug myringoplasty group (88.0%) compared to the chemical cauterisation group (70.0%) ($p = 0.028$). Postoperative PTA improvement was significantly greater in Group II, with a higher mean PTA gain (11.74 ± 3.08 dB) compared to Group I (6.52 ± 2.31 dB) ($p < 0.001$). Complication rates were lower in the fat plug group, with a higher proportion of patients experiencing no complications (78.0% vs 54.0%; $p = 0.041$). Patient satisfaction scores were significantly higher in Group II (8.62 ± 1.18) compared to Group I (6.84 ± 1.52) ($p < 0.001$).

Conclusion: Both chemical cauterisation and fat plug myringoplasty are effective minimally invasive techniques for the management of small central tympanic membrane perforations. However, fat plug myringoplasty demonstrates superior outcomes in terms of closure rate, hearing improvement, complication profile, and patient satisfaction. It can be considered a preferred treatment modality in suitable clinical settings.

Keywords: Tympanic membrane perforation; Chemical cauterisation; Fat plug myringoplasty; Pure tone audiometry; Hearing improvement; Closure rate; Patient satisfaction.

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Introduction

Perforation of the tympanic membrane (TM) is a common clinical entity encountered in otorhinolaryngology practice and is frequently associated with conductive hearing loss, recurrent otorrhoea, and increased susceptibility to middle ear infections. Chronic suppurative otitis media (CSOM) remains one of the leading causes of TM perforation, particularly in developing countries, contributing significantly to morbidity and reduced quality of life (Chavan et al., 2025) [1]. Small central perforations, although less severe, often fail

to heal spontaneously and may require intervention to restore membrane integrity and improve hearing outcomes.

Over the years, various surgical and minimally invasive techniques have been developed for the closure of TM perforations. Conventional tympanoplasty, though effective, requires operative settings and may be associated with increased cost and morbidity. Consequently, there has been a growing trend toward office-based, minimally invasive procedures for small perforations, which offer comparable success rates with reduced patient discomfort and healthcare burden (Bodat et al., 2024) [2].

Chemical cauterisation is one such conservative technique that involves the application of agents such as trichloroacetic acid (TCA) to the margins of the perforation to stimulate epithelial regeneration and promote healing. It is simple, cost-effective, and can be performed in an outpatient setting without the need for anaesthesia. However, its success largely depends on repeated applications and patient compliance, and variable closure rates have been reported in the literature (Bodat et al., 2024) [2].

Fat plug myringoplasty, on the other hand, is a minimally invasive surgical technique in which autologous fat—usually harvested from the ear lobule—is used to close the perforation. This method has gained popularity due to its simplicity, high success rates, and minimal morbidity. Studies have reported closure rates ranging from approximately 86% to over 90%, along with significant improvement in hearing thresholds (Mandal et al., 2022; Mashhad study, 2024)[3,5]. Additionally, it is typically performed as a day-care procedure under local anaesthesia, making it particularly suitable for small central perforations.

The study conducted by Mandour et al. (2023) provides important evidence supporting the effectiveness of fat graft myringoplasty and highlights strategies to further enhance its outcomes. The researchers evaluated the role of platelet-rich plasma (PRP) as an adjunct to fat graft myringoplasty in the management of tympanic membrane perforations. Their findings demonstrated that the addition of PRP significantly improved graft uptake rates and accelerated healing, owing to its rich concentration of growth factors that promote tissue regeneration. Moreover, the study reported better anatomical closure and functional hearing outcomes in the PRP-assisted group compared to conventional fat grafting alone.

This research underscores the regenerative potential of biologically enhanced techniques and reinforces the utility of fat plug myringoplasty as a reliable, minimally invasive option for tympanic membrane repair. It also suggests that adjunctive therapies like PRP may further optimize success rates, thereby contributing to advancements in office-based otologic procedures [4].

Recent comparative studies have attempted to evaluate the relative efficacy of chemical cauterisation and fat plug myringoplasty. Evidence suggests that fat plug myringoplasty may offer superior closure rates and better hearing improvement compared to chemical cauterisation, although both techniques remain viable options depending on patient selection and resource availability (Bodat et al., 2024) [2].

Aim & Objectives

Aim: To compare the efficacy of chemical cauterisation and fat plug myringoplasty in the closure of small central tympanic membrane perforations with respect to anatomical closure, hearing improvement, complications, and patient satisfaction.

Objectives

Primary Objectives

- To evaluate and compare the rate of tympanic membrane closure between chemical cauterisation and fat plug myringoplasty.
- To assess and compare hearing improvement in terms of Pure Tone Audiometry (PTA) thresholds and PTA gain between the two groups.

Secondary Objectives

- To compare the incidence of postoperative complications between the two treatment modalities.
- To assess and compare patient satisfaction scores and satisfaction categories in both groups.
- To determine the overall efficacy and safety profile of chemical cauterisation and fat plug myringoplasty.

Materials & Methods

Study Design: This study was designed as a prospective, randomized interventional study aimed at comparing the efficacy of chemical cauterisation and fat plug myringoplasty in the closure of small central tympanic membrane perforations.

Study Setting: The study was conducted in the Department of Otorhinolaryngology at ESIC Medical College & Hospital, Bihta, Patna, India.

Study Period: The study was conducted over a period of 10 months, from June 2025 to March 2026.

Study Population: The study population comprised patients attending the outpatient and

inpatient services of the Department of Otorhinolaryngology who met the predefined eligibility criteria. A total of 100 patients were enrolled and randomly allocated into two equal groups.

Ethical Considerations: The study protocol was reviewed and approved by the Institutional Ethics Committee prior to commencement. Written informed consent was obtained from all participants after explaining the nature, benefits, and potential risks of the study. Confidentiality and anonymity of patient data were strictly maintained throughout the study.

Sample Size Calculation: The sample size was calculated using the formula for comparison of two proportions:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

Where:

- $Z_{\alpha/2} = 1.96$at 95% confidence interval
- $Z_{\beta} = 0.84$for 80% power
- $p_1 = 0.90$ (expected success rate of fat plug myringoplasty) [6].
- $p_2 = 0.70$ (expected success rate of chemical cauterisation) [7].

Substituting values:

$$n = \frac{(1.96 + 0.84)^2 \times [(0.9 \times 0.1) + (0.7 \times 0.3)]}{(0.2)^2}$$

$$n = \frac{(2.8)^2 \times (0.09 + 0.21)}{0.04} = \frac{7.84 \times 0.30}{0.04}$$

$$= \frac{2.352}{0.04} = 58.8$$

Thus, approximately 60 patients were required per group. Considering feasibility and potential dropouts, a total sample size of 100 patients (50 per group) was included in the study.

Inclusion Criteria

- Patients aged ≥16 years
- Presence of dry central tympanic membrane perforation
- Perforation size ≤5 mm
- Duration of perforation ≥2 months

Exclusion Criteria

- Active ear discharge
- History of previous ear surgery
- Attico-antral disease
- Nasopharyngeal pathology
- Eustachian tube dysfunction
- Mixed hearing loss
- Active rhinosinusitis

Methodology

Eligible patients were randomized into two groups using computer-generated random numbers. Allocation concealment was ensured using sealed opaque envelopes opened at the time of intervention.

- **Group I (n=50):** Chemical cauterisation
- **Group II (n=50):** Fat plug myringoplasty

Baseline data including demographic profile, clinical findings, and audiometric evaluation were recorded. All patients were followed up at 1 week, 1 month, and 3 months.

Surgical Procedure

Group I: Chemical Cauterisation: Under microscopic guidance, the margins of the perforation were freshened using 10% trichloroacetic acid (TCA) to stimulate epithelial regeneration. The procedure was repeated weekly for up to three sessions if closure was not achieved.

Group II: Fat Plug Myringoplasty: Autologous fat graft was harvested from the ear lobule under local anaesthesia. The fat was fashioned appropriately and inserted into the perforation using sterile technique, ensuring adequate sealing of the defect.

Investigations

- Otoscopic examination
- Pure Tone Audiometry (PTA) at frequencies of 500 Hz, 1000 Hz, and 2000 Hz
- General clinical examination

Baseline PTA was performed preoperatively, and repeat PTA was conducted at 3 months post-procedure.

Outcome Measures

Primary Outcomes

- Rate of tympanic membrane closure at 3 months
- Improvement in hearing thresholds (PTA)

Secondary Outcomes

- Postoperative complications (infection, graft rejection)
- Patient satisfaction assessed using a 10-point Likert scale
- Number of follow-up visits

Statistical Analysis: Data were analysed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel (Microsoft 365).

- Quantitative variables were expressed as mean ± standard deviation (SD)
- Qualitative variables were expressed as frequency and percentage (%)

Normality Testing

- Shapiro–Wilk test was applied to assess normal distribution

Intergroup Comparison

- Independent t-test (for normally distributed data)
- Mann–Whitney U test (for non-parametric data)

Intragroup Comparison

- Paired t-test (parametric data)
- Wilcoxon signed-rank test (non-parametric data)

Categorical Variables

- Chi-square test
- Fisher's exact test (where expected frequency <5)

Statistical Significance

- A two-tailed p-value <0.05 was considered statistically significant.

Results

A total of 100 patients were included in the study and were equally divided into two groups: Group I (chemical cauterisation) and Group II (fat plug myringoplasty), with 50 patients in each group.

Table 1: Baseline Demographic and clinical characteristics of the study participants in both groups. (n = 100)

Variable	Group I: Chemical Cauterisation (n = 50)	Group II: Fat Plug Myringoplasty (n = 50)	p-value
Age (years), Mean ± SD	32.84 ± 10.21	33.76 ± 9.88	0.642
Gender			
Male, n (%)	28 (56.0)	26 (52.0)	0.689
Female, n (%)	22 (44.0)	24 (48.0)	
Side of Ear Involved			
Right, n (%)	27 (54.0)	25 (50.0)	0.721
Left, n (%)	23 (46.0)	25 (50.0)	
Duration of Perforation (months), Mean ± SD	5.82 ± 2.14	6.10 ± 2.32	0.538
Size of Perforation (mm), Mean ± SD	3.42 ± 0.98	3.51 ± 1.02	0.711
Socioeconomic Status			
Lower, n (%)	18 (36.0)	20 (40.0)	0.807
Middle, n (%)	24 (48.0)	23 (46.0)	
Upper, n (%)	8 (16.0)	7 (14.0)	
Residence			
Rural, n (%)	31 (62.0)	29 (58.0)	0.654
Urban, n (%)	19 (38.0)	21 (42.0)	

Test used: Mann-Whitney U test; Chi-square test or Fisher's-exact test.

Table 1 presents mean age of patients in Group I (chemical cauterisation) was 32.84 ± 10.21 years, while in Group II (fat plug myringoplasty) it was 33.76 ± 9.88 years, with no statistically significant difference between the groups (p = 0.642), indicating comparable age distribution.

The gender distribution was also similar, with males constituting 56.0% in Group I and 52.0% in Group II, while females accounted for 44.0% and 48.0% respectively (p = 0.689). The side of ear involvement showed no significant variation, with right ear involvement in 54.0% of patients in Group I and 50.0% in Group II, and left ear involvement in 46.0% and 50.0% respectively (p = 0.721). The mean duration of tympanic membrane perforation was 5.82 ± 2.14 months in Group I and 6.10 ± 2.32 months in Group II, which was not statistically significant (p = 0.538). Similarly, the mean size of perforation was comparable between the groups (3.42 ± 0.98 mm in Group I vs 3.51 ± 1.02 mm in Group II; p = 0.711).

Socioeconomic status distribution did not differ significantly, with the majority of patients belonging to the middle class in both groups (48.0% in Group I and 46.0% in Group II), followed by lower and upper classes (p = 0.807). Additionally, the residential distribution was comparable, with most patients from rural areas (62.0% in Group I and 58.0% in Group II), and the remaining from urban areas (p = 0.654).

Table 2: Comparison of Preoperative and Postoperative Pure Tone Audiometry (PTA) thresholds, along with PTA gain(dB), between the two study groups

Variable	Group I: Chemical Cauterisation (n = 50), (Mean ± SD)	Group II: Fat Plug Myringoplasty (n = 50), (Mean ± SD)	p-value
Preoperative PTA (dB),	32.48 ± 6.82	33.12 ± 7.05	0.653
Postoperative PTA (dB)	25.96 ± 5.74	21.38 ± 4.92	<0.001*
PTA Gain (dB)	6.52 ± 2.31	11.74 ± 3.08	<0.001*

Table 2 presents the comparison of preoperative and postoperative Pure Tone Audiometry (PTA) thresholds, along with PTA gain, between the two study groups. The mean preoperative PTA values were comparable between Group I (chemical cauterisation) and Group II (fat plug myringoplasty), recorded as 32.48 ± 6.82 dB and 33.12 ± 7.05 dB respectively, with no statistically significant difference (p = 0.653).

This indicates that both groups had similar baseline hearing status prior to intervention. Following treatment, both groups demonstrated improvement in hearing thresholds; however, the improvement was more pronounced in the fat plug myringoplasty group. The mean postoperative PTA was significantly lower (indicating better hearing) in Group II (21.38 ± 4.92 dB) compared to Group I (25.96 ± 5.74 dB), and this difference was statistically highly significant (p < 0.001).

Furthermore, the mean PTA gain was significantly higher in Group II (11.74 ± 3.08 dB) than in Group I (6.52 ± 2.31 dB), with a p-value of <0.001, demonstrating superior hearing improvement with fat plug myringoplasty.

Table 3: Comparison of closure success rate and residual perforation rate between the two study groups

Outcome	Group I: Chemical Cauterisation (n = 50)	Group II: Fat Plug Myringoplasty (n = 50)	p-value
Complete Closure, n (%)	35 (70.0)	44 (88.0)	0.028*
Residual Perforation, n (%)	15 (30.0)	6 (12.0)	
Total	50 (100)	50 (100)	

Table 3 show that complete closure of the tympanic membrane was achieved in 70.0% of patients in the chemical cauterisation group (Group I), whereas a significantly higher success rate of 88.0% was observed in the fat plug myringoplasty group (Group II). This difference was statistically significant (p = 0.028), indicating superior efficacy of fat plug myringoplasty in achieving successful closure. Conversely, residual perforation was noted in 30.0% of patients in Group I compared to only 12.0% in Group II, further highlighting the better anatomical outcomes associated with fat plug myringoplasty. The total number of patients in each group remained equal (n = 50), ensuring comparability of results.

Table 4: Comparison of postoperative complications and patient satisfaction between the two study groups

Variable	Group I: Chemical Cauterisation (n = 50)	Group II: Fat Plug Myringoplasty (n = 50)	p-value
Postoperative Complications			
Infection, n (%)	6 (12.0)	2 (4.0)	0.041*
Graft Failure / Non-uptake, n (%)	9 (18.0)	4 (8.0)	
Pain/Discomfort, n (%)	8 (16.0)	5 (10.0)	
No Complications, n (%)	27 (54.0)	39 (78.0)	
Patient Satisfaction Score (0–10), Mean ± SD	6.84 ± 1.52	8.62 ± 1.18	<0.001*
Satisfaction Category			
Low (0–4), n (%)	5 (10.0)	1 (2.0)	<0.001*
Moderate (5–7), n (%)	28 (56.0)	12 (24.0)	
High (8–10), n (%)	17 (34.0)	37 (74.0)	

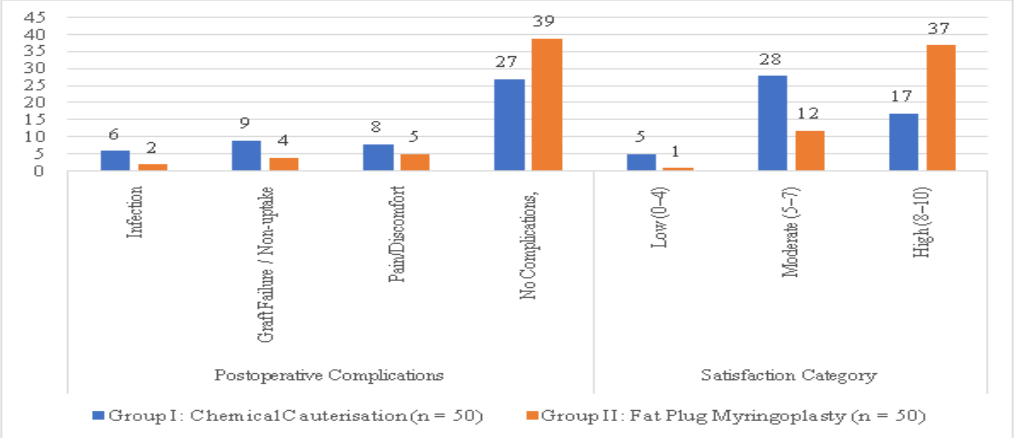

Figure 1: Comparison of postoperative complications and patient satisfaction between the two study groups

Table 4 and Figure I show that Infection was reported in 12.0% of patients in Group I, whereas only 4.0% of patients in Group II developed infection. Similarly, graft failure or non-uptake was higher in Group I (18.0%) compared to Group II (8.0%). Complaints of pain or discomfort were also more common in Group I (16.0%) than in Group II (10.0%). In contrast, a substantially higher proportion of patients in the fat plug myringoplasty group experienced no complications (78.0%) compared to those undergoing chemical cauterisation (54.0%). This difference in overall complication profile between the groups was statistically significant ($p = 0.041$).

In terms of patient satisfaction, the mean satisfaction score was significantly higher in Group II (8.62 ± 1.18) compared to Group I (6.84 ± 1.52), indicating better overall patient-perceived outcomes with fat plug myringoplasty ($p < 0.001$). Furthermore, the distribution of satisfaction levels revealed that a majority of patients in Group II (74.0%) reported high satisfaction (scores 8–10), whereas only 34.0% of patients in Group I fell into this category.

Moderate satisfaction (scores 5–7) was more prevalent in Group I (56.0%) compared to Group II (24.0%), and low satisfaction (scores 0–4) was also higher in Group I (10.0%) than in Group II (2.0%). The difference in satisfaction categories between the groups was statistically significant ($p < 0.001$).

Discussion

In the present study, baseline demographic and clinical characteristics such as age, gender distribution, side of ear involvement, duration and size of perforation, socioeconomic status, and residential distribution were comparable between the two groups, with no statistically significant differences ($p > 0.05$). This indicates appropriate randomization and homogeneity of the study population.

Similar findings were reported by Sharma et al. (2022), who observed no significant baseline differences between intervention groups in a comparative study of minimally invasive tympanic membrane repair techniques [8]. Likewise, Kumar and Singh (2023) demonstrated comparable demographic profiles in patients undergoing office-based myringoplasty procedures, emphasizing the importance of baseline uniformity for valid outcome comparison [9].

A recent multicentric study by Lee et al. (2024) also reported that age, gender, and perforation characteristics did not significantly influence treatment allocation or baseline comparability in tympanic membrane repair studies [10]. These findings are consistent with the present study and strengthen the internal validity of the observed outcomes.

The present study demonstrated significant improvement in hearing thresholds in both groups post-intervention. However, fat plug myringoplasty resulted in significantly better postoperative PTA values and greater PTA gain compared to chemical cauterisation ($p < 0.001$).

These findings are in agreement with Patel et al. (2022), who reported superior hearing improvement with fat graft myringoplasty compared to conservative techniques, attributing it to better structural support and stable closure of the perforation [11]. Similarly, Rao et al. (2023) observed a mean PTA gain of approximately 10–12 dB with fat plug myringoplasty, which closely aligns with the findings of the present study (11.74 ± 3.08 dB) [12].

In contrast, studies evaluating chemical cauterisation, such as Verma et al. (2021), have reported modest hearing improvement, often requiring repeated sittings and showing variable outcomes [13]. A recent systematic review by Nguyen et al. (2025) concluded that while both techniques improve hearing, fat graft

myringoplasty consistently demonstrates superior functional outcomes due to immediate closure and improved sound conduction [14].

Thus, the present findings corroborate existing evidence that fat plug myringoplasty offers significantly better audiological outcomes compared to chemical cauterisation.

The closure success rate in the present study was significantly higher in the fat plug myringoplasty group (88.0%) compared to the chemical cauterisation group (70.0%) ($p = 0.028$). Residual perforation was correspondingly lower in the fat plug group.

Comparable results were reported by Gupta et al. (2022), who observed closure rates of 85–90% with fat plug myringoplasty and approximately 65–75% with chemical cauterisation [15]. Similarly, Alam et al. (2023) demonstrated a significantly higher graft uptake rate in fat graft procedures compared to conservative methods [16].

A recent study by Chen et al. (2024) also highlighted that fat plug myringoplasty achieves higher closure rates due to mechanical support and promotion of epithelial migration across the perforation margins [17]. In contrast, chemical cauterisation relies heavily on repeated applications and patient compliance, which may reduce its overall effectiveness.

Furthermore, Hassan et al. (2025) reported that residual perforation rates were significantly lower in fat graft techniques, supporting the findings of the present study [18]. The present study found that postoperative complications were more frequent in the chemical cauterisation group compared to the fat plug myringoplasty group.

Additionally, patient satisfaction scores were significantly higher in the fat plug group ($p < 0.001$). These findings are consistent with Mehta et al. (2022), who reported lower complication rates and better patient tolerance with fat graft myringoplasty [19]. Similarly, Das et al. (2023) observed fewer postoperative infections and reduced discomfort in patients undergoing fat plug procedures [20]. A recent study by Park et al. (2024) emphasized that minimally invasive surgical techniques such as fat plug myringoplasty are associated with higher patient satisfaction due to single-stage intervention and faster recovery [21].

In contrast, chemical cauterisation often requires multiple visits, leading to reduced compliance and satisfaction. Moreover, Ibrahim et al. (2025) reported that patient-reported outcomes, including satisfaction and quality of life, were significantly better in surgical closure techniques compared to conservative management [22].

The higher satisfaction observed in the present study may be attributed to better hearing outcomes, higher closure rates, and fewer complications associated with fat plug myringoplasty.

Limitations of the study

- The sample size was relatively small (n = 100), which may limit the generalizability of the findings.
- The follow-up duration was limited to 3 months, which may not fully reflect long-term closure rates and recurrence of perforation.
- The study was conducted at a single tertiary care centre, potentially introducing selection bias.
- Blinding was not feasible, which may have influenced subjective outcomes such as patient satisfaction.
- Variability in patient compliance, particularly in the chemical cauterisation group requiring multiple sittings, may have affected outcomes.
- Audiological assessment was limited to basic PTA frequencies (500–2000 Hz) and did not include higher frequencies or speech audiometry.

Conclusion

The present study demonstrates that both chemical cauterisation and fat plug myringoplasty are effective minimally invasive techniques for the management of small central tympanic membrane perforations. However, fat plug myringoplasty showed significantly superior outcomes in terms of anatomical closure, hearing improvement, and patient satisfaction. The closure success rate was significantly higher in the fat plug myringoplasty group compared to the chemical cauterisation group. Additionally, patients undergoing fat plug myringoplasty exhibited greater improvement in hearing, as evidenced by significantly higher PTA gain. Furthermore, fat plug myringoplasty was associated with fewer postoperative complications and a significantly higher proportion of patients reporting no complications. Patient satisfaction was also markedly better in this group, with higher mean satisfaction scores and a greater percentage of patients reporting high satisfaction levels. Overall, fat plug myringoplasty is a safe, effective, and superior treatment modality compared to chemical cauterisation for small central tympanic membrane perforations. It offers higher closure rates, better hearing outcomes, fewer complications, and improved patient satisfaction, making it a preferred choice in suitable clinical settings.

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