

RESEARCH ARTICLE

Hearing recovery and disease-specific quality of life after tympanoplasty for safe-type chronic otitis media: a prospective longitudinal cohort study

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ABSTRACT

Background: Tympanoplasty is the standard surgical treatment for safe-type chronic otitis media (COM), yet its impact on hearing recovery and patient-reported quality of life (QoL) requires further evaluation. This study investigated postoperative changes in hearing function and QoL and their association following tympanoplasty.

Methods: This prospective longitudinal cohort study included patients with safe-type COM who underwent tympanoplasty. Hearing function was assessed using pure-tone audiometry, and QoL was evaluated using the Chronic Otitis Media Questionnaire-12 (COMQ-12) before surgery and three months postoperatively. Paired t-test and Wilcoxon signed-rank test were used to compare pre- and postoperative outcomes. Spearman's correlation and Univariable Linear Regression Analysis were performed to evaluate the relationship between hearing outcomes and QoL.

Results: Mean pure-tone average improved significantly from 50.37 ± 16.10 dB preoperatively to 31.93 ± 16.06 dB postoperatively, with a mean hearing gain of 18.26 ± 10.77 dB ($p < 0.001$). Median COMQ-12 scores significantly decreased from 32.0 (16.0–55.0) to 18.0 (0.0–40.0) ($p < 0.001$), indicating improved QoL. Although postoperative hearing threshold was significantly associated with postoperative disease-specific quality of life, hearing gain showed no significant correlation with COMQ-12 improvement ($r = -0.035$, $p = 0.832$). Univariable linear regression analysis demonstrated a significant association between postoperative hearing threshold and postoperative COMQ-12 score.

Conclusion: Tympanoplasty improves hearing function and disease-specific quality of life in patients with safe-type chronic otitis media. Postoperative hearing status was significantly associated with patient-reported quality of life, supporting the use of both audiometric and patient-reported outcome measures when evaluating surgical success.

Keywords: Chronic otitis media; tympanoplasty; hearing outcomes; pure-tone audiometry; COMQ-12; patient-reported outcome measures; health-related quality of life.

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Introduction

Chronic otitis media (COM) is a common chronic inflammatory disease of the middle ear characterized by persistent tympanic membrane perforation, recurrent otorrhea, and conductive hearing loss. A recent systematic review estimated that COM affects approximately 297 million people worldwide (3.8% prevalence), with 85% of cases occurring in low- and middle-income countries and 62% associated with disabling hearing loss, underscoring its substantial global health burden[1].

Hearing loss is the principal functional consequence of chronic otitis media (COM) and is frequently accompanied by persistent otorrhea and tinnitus, adversely affecting communication, social participation, and psychological well-being. These manifestations substantially impair health-related quality of life, emphasizing the importance of evaluating patient-reported outcomes alongside conventional clinical and audiometric assessment[2, 3].

Although postoperative hearing improvement has been consistently reported, whether audiometric recovery ac-

curately reflects patients' perceived functional recovery remains uncertain. Postoperative hearing outcomes are commonly assessed using pure-tone audiometry (PTA), the gold standard for measuring hearing thresholds. Contemporary evidence has demonstrated that tympanoplasty provides significant improvements in hearing function and health-related quality of life, supporting its role as an effective intervention for functional rehabilitation in patients with chronic otitis media[4, 5].

Although audiometric assessment objectively reflects hearing recovery, it does not fully capture patients' perceptions of symptom relief and functional improvement in daily life. Consequently, patient-reported outcome measures (PROMs) have become increasingly important for evaluating the effectiveness of otologic interventions. Among the available disease-specific instruments, the Chronic Otitis Media Questionnaire-12 (COMQ-12) is a validated tool that assesses symptom severity, hearing disability, lifestyle restrictions, healthcare utilization, and health-related quality of life in patients with chronic otitis media [2, 6].

Although tympanoplasty has been shown to improve hearing and health-related quality of life, the extent to

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which postoperative hearing recovery translates into better patient-reported outcomes remains uncertain. Previous studies have reported inconsistent associations between audiometric improvement and quality of life, suggesting that postoperative outcomes are influenced by multiple clinical and psychosocial factors beyond hearing thresholds alone. Consequently, combining objective audiometric measures with disease-specific patient-reported outcome instruments may provide a more comprehensive assessment of tympanoplasty outcomes [7, 8].

To date, evidence regarding the association between hearing recovery and disease-specific quality of life following tympanoplasty remains limited in Indonesia, particularly in Eastern Indonesia. Most available studies have primarily focused on anatomical graft success and postoperative hearing improvement without simultaneously evaluating patient-reported outcomes using validated disease-specific instruments. To our knowledge, this is one of the first prospective longitudinal studies from Eastern Indonesia integrating objective audiometric outcomes with the Chronic Otitis Media Questionnaire-12 (COMQ-12) to evaluate the relationship between postoperative hearing recovery and disease-specific quality of life following tympanoplasty. Therefore, this study aimed to evaluate changes in hearing function and quality of life before and after tympanoplasty and to determine whether postoperative hearing recovery is associated with patient-reported quality of life. The findings are expected to provide a more comprehensive evaluation of tympanoplasty outcomes and support the integration of patient-reported outcome measures into routine otologic practice.

Methods

Study Design and Ethical Considerations

This prospective longitudinal cohort study was conducted to evaluate changes in hearing function and disease-specific quality of life following tympanoplasty in patients with safe-type chronic otitis media (COM). The study was conducted at Dr. Wahidin Sudirohusodo Hospital, Hasanuddin University Hospital, Labuang Baji Regional Hospital, and Akademis Hospital, Makassar, Indonesia, between October 2025 and April 2026. The study protocol was approved by the Health Research Ethics Committee of the Faculty of Medicine, Hasanuddin University (Approval No.: UH25110971). Written informed consent was obtained from all participants before enrolment. All procedures were performed in accordance with the ethical principles of the Declaration of Helsinki, and patient confidentiality was strictly maintained throughout the study.

Study Population and Sampling

Patients diagnosed with safe-type chronic otitis media who underwent tympanoplasty during the study period were consecutively recruited. Eligible participants were adults diagnosed with safe-type COM based on clinical examina-

tion, otomicroscopy, and audiological evaluation and who agreed to participate in the study.

The inclusion criteria were patients aged ≥ 18 years, diagnosed with safe-type COM, undergoing primary tympanoplasty, and completing both preoperative and three-month postoperative audiological and quality-of-life assessments. Exclusion criteria included previous middle ear surgery, cholesteatoma, congenital ear anomalies, sensorineural hearing loss, incomplete follow-up, or incomplete questionnaire data.

Because this was a prospective longitudinal study requiring complete preoperative and postoperative evaluations, only patients who completed all scheduled assessments were included in the final analysis.

Hearing Assessment

Hearing function was evaluated using pure-tone audiometry (PTA) before surgery and three months after tympanoplasty. Air-conduction hearing thresholds were measured at 0.5, 1, 2, and 4 kHz, and the pure-tone average (PTA) was calculated as the mean threshold across these frequencies. Hearing improvement (hearing gain) was calculated by subtracting the postoperative PTA from the preoperative PTA, with larger values indicating greater hearing recovery.

Quality of Life Assessment

Disease-specific quality of life was assessed using the Chronic Otitis Media Questionnaire-12 (COMQ-12), a validated patient-reported outcome measure specifically developed for chronic otitis media. The questionnaire consists of 12 items evaluating symptom severity, hearing disability, lifestyle restriction, healthcare utilization, and overall health-related quality of life. Participants completed the Indonesian version of the COMQ-12 before surgery and again three months after tympanoplasty. Individual item scores ranged from 0 to 5, with higher total scores indicating poorer quality of life.

Surgical Procedure

All patients underwent tympanoplasty performed by otologic surgeons following the standard surgical protocol at Dr. Wahidin Sudirohusodo Hospital. Surgical techniques were selected according to intraoperative findings and the extent of tympanic membrane perforation. Routine postoperative management and follow-up were performed according to institutional protocols. The surgical approach (transcanal or transmastoid) and graft material (temporalis fascia or cartilage) were selected according to intraoperative findings and surgeon preference.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median (interquartile range) according

to data distribution, whereas categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test. Preoperative and postoperative hearing thresholds were compared using the paired t-test, whereas COMQ-12 scores were analyzed using the Wilcoxon signed-rank test because of their non-normal distribution. The association between hearing function and quality of life was evaluated using Spearman's rank correlation coefficient. To identify significant associations of postoperative quality of life, Univariable Linear Regression analysis was performed using postoperative COMQ-12 score as the dependent variable and using postoperative pure-tone average as the explanatory variable. A two-sided p-value <0.05 was considered statistically significant.

Strengths and Limitations of the Study

Because this was a prospective longitudinal study with repeated within-subject measurements, each participant served as his or her own control, thereby reducing inter-individual variability and improving the ability to detect postoperative changes. Nevertheless, the relatively small sample size and multicenter study involving four hospitals design may limit the generalizability of the findings. Therefore, the present study should be considered exploratory, and further multicenter studies with larger populations are warranted to validate these findings.

Ethical statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Medicine, Hasanuddin University, Makassar, Indonesia (Protocol Number: UH25110971). Written informed consent was obtained from all participants prior to enrolment and data collection.

Results

Demographic and Clinical Characteristics

A total of 45 patients with chronic otitis media were assessed for eligibility during the study period. Five patients were excluded because they did not meet the inclusion criteria or declined participation. Consequently, 40 eligible patients were enrolled in the study. All participants underwent tympanoplasty and completed the scheduled three-month postoperative follow-up, including PTA and COMQ-12 assessments. No participants were lost to follow-up, and all enrolled patients were included in the final analysis.

The demographic and clinical characteristics of the study population are summarized in Table 1. The mean age was 26.30 ± 11.9 years, with most participants aged 18–30 years (75.0%). Male patients were slightly more prevalent than females (55.0% vs. 45.0%). Clinically, active chronic otitis media was the predominant presentation (70.0%), while inactive disease accounted for 30.0% of cases. Most patients had large tympanic membrane perforations (>50%) (72.5%), followed by medium-sized (20.0%) and small perforations (7.5%). Tympanoplasty was performed more frequently in the left ear (57.5%) than in the right ear (42.5%), as summarized in Table 1.

Hearing function was evaluated using pure-tone audiometry (PTA), whereas disease-specific quality of life was assessed using the Chronic Otitis Media Questionnaire-12 (COMQ-12) before surgery and three months after tympanoplasty. These repeated assessments enabled comprehensive evaluation of postoperative hearing recovery and patient-reported quality-of-life outcomes.

Hearing Outcomes After Tympanoplasty

Preoperative and postoperative hearing thresholds are presented in Table 2. Tympanoplasty resulted in a significant improvement in hearing function, with the mean pure-

Table 1. Demographic and Clinical Characteristics of Patients Undergoing Tympanoplasty (n = 40)

Characteristic	Category	n (%)
Age, years	Mean $\pm$ SD	26.30 $\pm$ 11.9
	18–30	30 (75.0)
	31–45	5 (12.5)
	46–60	5 (12.5)
Sex	Male	22 (55.0)
	Female	18 (45.0)
Clinical diagnosis	Active chronic otitis media	28 (70.0)
	Inactive chronic otitis media	12 (30.0)
Tympanic membrane perforation size	Small (<25%)	3 (7.5)
	Medium (25–50%)	8 (20.0)
	Large (>50%)	29 (72.5)
Operated ear	Right	17 (42.5)
	Left	23 (57.5)
Surgical approach	Transcanal	33 (82.5)
	Transmastoid	7 (17.5)
Graft material	Temporalis fascia	8 (20.0)
	Cartilage	32 (80.0)

tone average (PTA) improving from 50.37 ± 16.10 dB before surgery to 31.93 ± 16.06 dB three months postoperatively ($p < 0.001$). The mean hearing gain was 18.26 ± 10.77 dB, with significant improvements observed across all tested frequencies (500, 1000, 2000, and 4000 Hz), demonstrating successful auditory rehabilitation following surgery.

Quality of Life Outcomes

Disease-specific quality of life also improved significantly after tympanoplasty (Table 3). The median COMQ-12 score decreased from 32.0 (16.0–55.0) preoperatively to 18.0 (0.0–40.0) three months after surgery ($p < 0.001$), indicating a marked reduction in symptom burden and improvement in health-related quality of life. Significant improvements were observed in symptom severity and hearing-related disability, whereas changes in lifestyle restriction and water precaution were less pronounced.

Table 3 summarizes the audiometric outcomes before and three months after tympanoplasty. Significant improvements were observed at all evaluated frequencies (500, 1000, 2000, and 4000 Hz), with all comparisons demonstrating statistical significance ($p < 0.001$). The median pure-tone average (PTA) improved from 48.75 dB HL preoperatively to 25.63 dB HL postoperatively ($p < 0.001$). The mean hearing gain following surgery was 18.26 ± 10.77 dB HL, indicating substantial postoperative improvement in hearing function.

Association Between Hearing Recovery and Quality of Life

Spearman's correlation analysis demonstrated that hearing gain was not significantly associated with improvement in COMQ-12 scores ($r = -0.035$, $p = 0.832$). In contrast, postoperative hearing threshold showed a significant positive association with postoperative COMQ-12 score, indicating that poorer postoperative hearing was associated

Table 2. Severity and Type of Hearing Loss Before and Three Months After Tympanoplasty

Characteristic	Category	Preoperative n (%)	Postoperative n (%)
Severity of hearing loss	Normal (≤ 25 dB)	1 (2.5)	19 (47.5)
	Mild (26–40 dB)	12 (30.0)	14 (35.0)
	Moderate (41–60 dB)	17 (42.5)	4 (10.0)
	Severe (61–80 dB)	9 (22.5)	3 (7.5)
	Profound (> 80 dB)	1 (2.5)	0 (0.0)
Type of hearing loss	Conductive	35 (87.5)	17 (42.5)
	Mixed	4 (10.0)	4 (10.0)
	Normal hearing	1 (2.5)	19 (47.5)

Table 3. Comparison of Hearing Thresholds Before and Three Months After Tympanoplasty (n = 40)

Frequency	Preoperative Median (Min–Max), dB HL	Postoperative Median (Min–Max), dB HL	p-value
500 Hz	50.0 (10.0–85.0)	30.0 (10.0–70.0)	$< 0.001^*$
1000 Hz	50.0 (15.0–85.0)	25.0 (10.0–75.0)	$< 0.001^*$
2000 Hz	40.0 (10.0–85.0)	25.0 (10.0–75.0)	$< 0.001^*$
4000 Hz	50.0 (10.0–90.0)	30.0 (10.0–85.0)	$< 0.001^*$
Pure-tone average (PTA)	48.75 (11.25–83.75)	25.63 (13.75–75.00)	$< 0.001^*$

Hearing gain (mean $\pm$ SD): 18.26 ± 10.77 dB HL

Values are presented as median (minimum–maximum), unless otherwise indicated. P-values were calculated using the Wilcoxon signed-rank test. A p-value < 0.05 was considered statistically significant.

Table 4. Comparison of COMQ-12 Scores Before and Three Months After Tympanoplasty (n = 40)

COMQ-12 Item	Preoperative Median (Min–Max)	Three Months Postoperative Median (Min–Max)	p-value
Q1	3.0 (1.0–5.0)	0.0 (0.0–4.0)	< 0.001
Q2	3.0 (1.0–5.0)	0.0 (0.0–5.0)	< 0.001
Q3	2.0 (0.0–5.0)	1.0 (0.0–5.0)	< 0.001
Q4	3.0 (0.0–5.0)	1.0 (0.0–5.0)	< 0.001
Q5	3.0 (0.0–5.0)	1.0 (0.0–5.0)	< 0.001
Q6	1.0 (0.0–5.0)	0.0 (0.0–3.0)	< 0.001
Q7	2.5 (0.0–5.0)	2.0 (0.0–4.0)	0.001
Q8	2.0 (0.0–5.0)	2.0 (0.0–5.0)	0.233
Q9	3.5 (0.0–5.0)	3.0 (0.0–4.0)	0.135
Q10	4.0 (0.0–5.0)	2.0 (0.0–4.0)	0.001
Q11	3.0 (0.0–5.0)	2.0 (0.0–5.0)	< 0.001
Q12	4.0 (1.0–5.0)	3.0 (0.0–5.0)	< 0.001
Total COMQ-12 score	32.0 (16.0–55.0)	18.0 (0.0–40.0)	< 0.001

Mean change in COMQ-12 score: 13.92 ± 9.44

Values are presented as median (minimum–maximum), unless otherwise indicated. Comparisons were performed using the Wilcoxon signed-rank test. A two-sided $p < 0.05$ was considered statistically significant.

with poorer disease-specific quality of life.

Disease-specific quality of life improved significantly following tympanoplasty (Table 4). The median total COMQ-12 score decreased from 32.0 (16.0–55.0) preoperatively to 18.0 (0.0–40.0) three months after surgery ($p < 0.001$), corresponding to a mean score reduction of 13.92 ± 9.44 points. Significant improvements were observed in 10 of the 12 COMQ-12 items, particularly those related to hearing difficulty, ear discharge, symptom burden, and healthcare utilization. In contrast, no significant changes were found for Q8 ($p = 0.233$) and Q9 ($p = 0.135$), indicating that these domains were less responsive to surgical intervention.

Spearman's correlation analysis demonstrated a significant positive correlation between hearing threshold and COMQ-12 score both before surgery ($r = 0.357$, $p =$

0.024) and three months after tympanoplasty ($r = 0.580$, $p < 0.001$), indicating that poorer hearing thresholds were associated with worse disease-specific quality of life. However, no significant correlation was observed between hearing gain and improvement in COMQ-12 score ($r = -0.035$, $p = 0.832$), suggesting that the magnitude of audiometric improvement did not directly correspond to the magnitude of quality-of-life improvement following surgery.

Univariable linear regression analysis demonstrated a significant association between postoperative hearing threshold and postoperative disease-specific quality of life (Table 6). Higher postoperative hearing thresholds were significantly associated with higher COMQ-12 scores, indicating poorer quality of life ($B = 0.355$, 95% CI 0.221–0.490, $\beta = 0.655$, $p < 0.001$).

Table 5. Correlation Between Hearing Thresholds and Disease-Specific Quality of Life Before and After Tympanoplasty (n = 40)

Variables	Mean $\pm$ SD	Spearman's r	p-value
Preoperative			
Pure-tone average (dB HL)	50.37 $\pm$ 16.10	0.357	0.024
COMQ-12 score	33.35 $\pm$ 7.68		
Postoperative			
Pure-tone average (dB HL)	31.93 $\pm$ 16.06	0.580	<0.001
COMQ-12 score	18.78 $\pm$ 8.71		
Change after tympanoplasty			
Hearing gain (dB HL)	18.26 $\pm$ 10.77	-0.035	0.832
Change in COMQ-12 score	13.92 $\pm$ 9.44		

Abbreviations: COMQ-12, Chronic Otitis Media Questionnaire-12; dB HL, decibel hearing level.

Correlation analysis was performed using Spearman's rank correlation coefficient. A two-sided $p < 0.05$ was considered statistically significant.

Table 6. Univariable Linear Regression Analysis of Factors Associated with Postoperative COMQ-12 Score

Variable	B	SE	Standardized β	t	p-value	95% CI
Constant	7.424	2.369	—	3.13	0.003	2.628 to 12.221
Postoperative pure-tone average (dB HL)	0.355	0.066	0.655	5.340	<0.001	0.221 to 0.490

Dependent variable: Postoperative COMQ-12 score.

Univariable linear regression analysis was performed to identify factors associated with postoperative disease-specific quality of life. A two-sided $p < 0.05$ was considered statistically significant.

Discussion

This prospective longitudinal study demonstrated that tympanoplasty significantly improved both hearing function and disease-specific quality of life in patients with safe-type chronic otitis media (COM). Significant improvements were observed in hearing thresholds at all evaluated frequencies, with the median pure-tone average (PTA) improving from 48.75 dB HL before surgery to 25.63 dB HL three months postoperatively ($p < 0.001$). The mean hearing gain was 18.26 ± 10.77 dB HL, indicating substantial restoration of auditory function following surgery. Likewise, the median COMQ-12 score decreased significantly from 32.0 to 18.0 ($p < 0.001$), reflecting marked improvement in disease-specific quality of life. Although postoperative hearing thresholds were significantly correlated with COMQ-12 scores ($r = 0.580$, $p < 0.001$), hearing gain itself was not associated with the magnitude of quality-of-life improvement ($r = -0.035$, $p = 0.832$). These findings suggest that the hearing level achieved after surgery is more clinically relevant to patients than the numerical improvement in hearing thresholds.

The demographic characteristics observed in the present

study were generally consistent with previous reports describing the epidemiology of chronic suppurative otitis media. Most participants were young adults, 55% were male, 70% had active disease, and 72.5% presented with large tympanic membrane perforations. Chronic suppurative otitis media remains one of the most prevalent chronic inflammatory diseases of the middle ear, particularly in low- and middle-income countries where delayed diagnosis, recurrent infections, and limited access to healthcare contribute to persistent disease and hearing impairment. Large tympanic membrane perforations are frequently associated with prolonged inflammation and progressive destruction of the tympanic membrane, resulting in greater conductive hearing loss and increased disease burden. Similar demographic and clinical profiles have been reported in recent epidemiological studies from Asia and Africa, confirming that delayed presentation remains a major challenge in the management of COM [9–12].

In the present study, tympanoplasty resulted in significant improvement in hearing function. Before surgery, moderate hearing loss was the most common finding (42.5%), whereas only one patient (2.5%) had normal

hearing. Three months after surgery, the proportion of patients with normal hearing increased to 47.5%, accompanied by a marked reduction in moderate and severe hearing loss. These findings demonstrate the effectiveness of tympanic membrane reconstruction in restoring sound transmission through the middle ear. Restoration of an intact tympanic membrane improves the vibratory surface available for sound conduction, while resolution of chronic inflammation and recurrent otorrhea further enhances middle-ear function. Similar postoperative hearing improvements have been consistently reported in recent studies evaluating tympanoplasty outcomes, confirming that successful reconstruction of the tympanic membrane is associated with significant functional hearing recovery. Our findings are further supported by Gaffar et al. (2026), who demonstrated that tympanoplasty without mastoidectomy achieved favorable anatomical and functional outcomes in both active and inactive tubotympanic chronic otitis media. Their findings suggest that successful hearing rehabilitation can be achieved without routine mastoidectomy in carefully selected patients, reinforcing the effectiveness of tympanoplasty as a hearing-restorative procedure. Although the present study did not compare surgical techniques, the significant postoperative improvement in hearing observed in our cohort is consistent with their conclusions [4, 5, 13, 14].

The observed hearing gain of 18.26 dB HL in the present study is comparable with previously published reports. Backous et al. emphasized that hearing rehabilitation remains one of the principal objectives of surgical management in chronic otitis media and that successful tympanoplasty substantially improves auditory performance. Similarly, Cavaliere et al. and Bukurov et al. demonstrated significant postoperative improvements in hearing thresholds accompanied by better patient-reported functional outcomes. Nevertheless, complete hearing recovery cannot always be achieved because postoperative hearing is influenced by several factors, including preoperative disease severity, perforation size, ossicular chain integrity, Eustachian tube function, and middle-ear mucosal status. Rumastika et al. further demonstrated that larger tympanic membrane perforations are positively correlated with poorer hearing thresholds, explaining why patients with extensive perforations may continue to experience residual hearing impairment despite technically successful surgery [4, 5, 15].

Although hearing outcomes improved significantly, a small proportion of patients continued to demonstrate moderate or severe hearing loss after surgery. Persistent postoperative hearing impairment has been reported in previous studies and may result from irreversible middle-ear pathology, ossicular abnormalities, residual inflammation, postoperative fibrosis, or inadequate Eustachian tube function. Therefore, anatomical closure of the tympanic membrane should not be regarded as the sole indicator of surgical success. Contemporary concepts of hearing rehabilitation emphasize that postoperative assessment should

integrate both objective audiometric evaluation and patient-reported functional outcomes to better reflect the real benefits experienced by patients [4, 13].

In addition to improving hearing function, tympanoplasty significantly enhanced disease-specific quality of life in the present study. The median total COMQ-12 score decreased from 32.0 (16.0–55.0) before surgery to 18.0 (0.0–40.0) three months postoperatively ($p < 0.001$), corresponding to a mean reduction of 13.92 ± 9.44 points. Significant improvements were observed in 10 of the 12 COMQ-12 items, particularly those related to hearing difficulty, ear discharge, ear discomfort, and the overall impact of chronic otitis media on daily activities. These findings indicate that the benefits of tympanoplasty extend beyond anatomical closure of the tympanic membrane by substantially reducing symptom burden and improving patients' perceived functional status. Similar improvements in disease-specific quality of life following surgical treatment have been consistently reported in patients with chronic otitis media, supporting the use of patient-reported outcome measures (PROMs) as an integral component of postoperative evaluation [5, 13].

The improvement in COMQ-12 scores observed in the present study is biologically plausible because tympanoplasty addresses the principal pathological mechanisms responsible for symptom generation in chronic otitis media. Closure of the tympanic membrane perforation reduces recurrent otorrhea, improves middle-ear protection, restores sound transmission, and decreases chronic inflammation. Consequently, patients experience fewer infections, improved communication, and greater confidence in social and occupational activities. These improvements are reflected not only in better hearing but also in reduced healthcare utilization and enhanced overall well-being. Similar postoperative improvements have been demonstrated in studies evaluating COMQ-12 and other disease-specific quality-of-life instruments following tympanoplasty [4, 5, 16].

Interestingly, although most COMQ-12 domains improved significantly, Items Q8 and Q9 did not demonstrate statistically significant postoperative changes. These findings suggest that certain aspects of disease-specific quality of life may recover more slowly than hearing-related symptoms. Behavioral adaptation, lifestyle modification, and long-standing psychosocial limitations often persist even after successful surgery because patients require time to regain confidence in daily activities and social participation. Furthermore, these domains may be influenced by factors unrelated to middle-ear function, including socioeconomic status, educational background, health literacy, and individual coping strategies. Similar observations have been reported in previous validation studies of the COMQ-12, which demonstrated that symptom-related domains generally improve earlier than psychosocial or behavioral domains following treatment [8, 16–18].

The significant reduction in COMQ-12 scores ob-

served in this study is consistent with the growing body of evidence supporting the responsiveness of COMQ-12 to clinical improvement after tympanoplasty. Since its original development by Phillips et al., the COMQ-12 has undergone extensive cross-cultural validation in multiple languages, including Portuguese, Spanish, Italian, Arabic, Korean, Turkish, Slovenian, Armenian, French, and Indonesian, consistently demonstrating good validity, reliability, and responsiveness to treatment-related changes. This widespread validation supports the applicability of COMQ-12 as a standardized instrument for evaluating disease-specific quality of life in patients with chronic otitis media across different populations and healthcare settings [19, 20].

These findings further reinforce the importance of incorporating patient-reported outcome measures into routine otologic practice. Although audiometric improvement remains an essential indicator of surgical success, objective hearing thresholds alone do not fully capture patients' perceptions of symptom relief, communication ability, emotional well-being, or functional recovery. Disease-specific PROMs such as the COMQ-12 provide complementary information that reflects the patient's perspective and therefore facilitate more comprehensive evaluation of treatment effectiveness. Contemporary otologic research increasingly recommends combining objective audiological assessment with validated PROMs to support patient-centered care and shared clinical decision-making [8, 13, 18].

Overall, the present findings demonstrate that tympanoplasty produces clinically meaningful improvements in disease-specific quality of life in patients with safe-type chronic otitis media. The substantial reduction in COMQ-12 scores confirms that successful surgical treatment not only restores hearing but also alleviates symptoms that interfere with patients' daily lives. These results support the routine use of COMQ-12 alongside pure-tone audiometry when evaluating postoperative outcomes, thereby providing a more comprehensive assessment of both functional recovery and patient-perceived benefit.

A notable finding of the present study was the significant positive correlation between hearing thresholds and COMQ-12 scores both before surgery ($r = 0.357$, $p = 0.024$) and three months after tympanoplasty ($r = 0.580$, $p < 0.001$). These results indicate that poorer hearing thresholds were associated with poorer disease-specific quality of life, confirming that hearing impairment remains one of the principal determinants of functional disability in patients with chronic otitis media. Hearing loss associated with COM adversely affects communication, social interaction, occupational performance, and emotional well-being, thereby contributing substantially to disease burden. Similar findings have been reported in the multinational COMQ-12 study by Phillips et al., which demonstrated that hearing disability and persistent ear discharge were the strongest contributors to reduced quality of life in patients

with chronic otitis media. Likewise, Lewis and Gergely emphasized that restoration of hearing is associated with meaningful improvements in health-related quality of life, highlighting hearing rehabilitation as an essential therapeutic goal in otologic care [3, 16, 21].

Interestingly, despite the significant association between postoperative hearing thresholds and quality of life, no significant correlation was observed between hearing gain and the improvement in COMQ-12 scores ($r = -0.035$, $p = 0.832$). This finding suggests that the magnitude of audiometric improvement does not necessarily translate into proportional improvement in patient-reported quality of life. Several factors may explain this discrepancy. First, patients evaluate treatment success not only by hearing improvement but also by symptom resolution, freedom from recurrent otorrhea, reduced anxiety about water exposure, and improved confidence in social situations. Second, baseline disease severity and individual expectations may influence patients' perceptions of recovery. Consequently, two patients with similar hearing gains may report markedly different postoperative quality-of-life outcomes. Previous studies have similarly demonstrated that objective audiometric outcomes and patient-reported outcome measures evaluate different dimensions of recovery and should therefore be interpreted as complementary rather than interchangeable indicators of surgical success [8, 13].

Univariable linear regression analysis further demonstrated that postoperative pure-tone average was significantly associated with postoperative COMQ-12 score ($B = 0.355$, $\beta = 0.655$, $p < 0.001$). This finding indicates that the hearing level achieved after surgery has greater clinical relevance than the absolute amount of hearing gain. From the patient's perspective, the ability to communicate effectively and perform daily activities is likely to be more important than the numerical improvement in hearing threshold. Therefore, postoperative hearing status may represent a more meaningful indicator of functional recovery and patient satisfaction than hearing gain alone. Similar conclusions have been reported by Backous et al., who emphasized that hearing rehabilitation should be evaluated according to functional benefit rather than audiometric outcomes alone, and by Cavaliere et al., who demonstrated that postoperative hearing status is closely associated with patient-perceived quality of life [4, 5, 13].

The present findings have important clinical implications. Conventional assessment of tympanoplasty outcomes has traditionally focused on graft uptake and postoperative hearing thresholds. However, the current study demonstrates that these objective measures do not fully reflect patients' perceptions of recovery. Routine incorporation of disease-specific patient-reported outcome measures such as the COMQ-12 may facilitate more comprehensive postoperative evaluation, identify patients who continue to experience substantial disease burden despite satisfactory audiometric outcomes, and support shared clinical deci-

sion-making. This approach is consistent with the increasing emphasis on value-based healthcare, where treatment success is evaluated from both clinical and patient perspectives [8, 13].

This study has several strengths. The prospective longitudinal design enabled direct within-subject comparisons before and after surgery, thereby minimizing inter-individual variability. Objective hearing outcomes were assessed using pure-tone audiometry, while disease-specific quality of life was evaluated using the validated COMQ-12 questionnaire, providing complementary measures of treatment effectiveness. Furthermore, this study evaluated both objective and subjective outcomes simultaneously, allowing a more comprehensive assessment of tympanoplasty than studies relying exclusively on audiometric measures. To our knowledge, this is among the first prospective studies from Indonesia to investigate the relationship between postoperative hearing outcomes and disease-specific quality of life using COMQ-12 in patients with safe-type chronic otitis media.

Several limitations should also be acknowledged. First, the relatively small sample size may have limited the statistical power to detect weaker associations, particularly regarding the relationship between hearing gain and quality-of-life improvement. Second, the follow-up period was limited to three months after surgery, precluding assessment of long-term hearing stability and sustained quality-of-life outcomes. Third, potentially important determinants such as Eustachian tube function, socioeconomic status, smoking status, psychological factors, and graft integrity were not included in the regression model. Future multicenter studies with larger sample sizes, longer follow-up, and more comprehensive evaluation of clinical and psychosocial variables are warranted to validate and extend the present findings.

Overall, the present study demonstrates that tympanoplasty significantly improves hearing function and disease-specific quality of life in patients with safe-type chronic otitis media. While postoperative hearing thresholds were significantly associated with quality of life, hearing gain itself was not, suggesting that patient-perceived recovery is influenced by multiple factors beyond audiometric improvement. These findings support the routine integration of pure-tone audiometry and the COMQ-12 into postoperative assessment, providing a more comprehensive and patient-centered evaluation of tympanoplasty outcomes and facilitating optimization of long-term patient care.

Comparison of Hearing Outcomes with Previous Studies

The present study demonstrated a mean hearing gain of 18.26 ± 10.77 dB HL, with the proportion of patients achieving normal hearing increasing from 2.5% preoperatively to 47.5% postoperatively. These findings are comparable to previous studies reporting postoperative hearing gains ranging from approximately 10–20 dB fol-

lowing successful tympanoplasty. Cavaliere et al. reported significant improvements in hearing thresholds accompanied by better postoperative quality of life, while Bukurov et al. similarly demonstrated that hearing restoration after chronic otitis media surgery was associated with meaningful functional recovery. The comparable hearing gain observed in the present study may be explained by the predominance of patients with conductive hearing loss and successful tympanic membrane reconstruction. Nevertheless, differences in hearing outcomes among studies may be attributed to variations in perforation size, ossicular chain integrity, graft material, surgical technique, duration of disease, and postoperative follow-up [4, 5, 13].

Comparison of Quality-of-Life Outcomes with Previous Studies

In addition to hearing improvement, the present study demonstrated a substantial reduction in disease-specific symptom burden, with the median COMQ-12 score decreasing from 32.0 before surgery to 18.0 three months after tympanoplasty, representing a mean improvement of 13.92 ± 9.44 points. This degree of improvement is consistent with previous studies demonstrating that successful tympanoplasty significantly improves disease-specific quality of life. Bukurov et al. reported marked improvements in quality-of-life scores after surgery after adjustment for placebo effects, while Cavaliere et al. found that patients experienced significant postoperative improvements in both symptom severity and overall health-related quality of life. Likewise, the systematic review by Schouwenaar et al. concluded that otologic surgery consistently improves patient-reported quality of life regardless of the assessment instrument used, although the magnitude of improvement varies according to baseline disease severity and follow-up duration [5, 13].

Interpretation of the Correlation Findings

An important finding of the present study was that postoperative hearing thresholds were significantly associated with postoperative COMQ-12 scores, whereas hearing gain was not significantly associated with changes in quality of life. This finding suggests that patients place greater value on their final hearing ability than on the numerical improvement achieved after surgery. Individuals with similar hearing gains may perceive different levels of benefit depending on residual hearing, communication ability, symptom resolution, and psychosocial adaptation. These observations are consistent with the multinational COMQ-12 study by Phillips et al., which demonstrated that hearing disability and persistent ear discharge contribute more substantially to quality of life than audiometric measures alone. Similarly, Mlynski et al. emphasized that disease-specific PROMs evaluate dimensions of recovery that are not adequately reflected by pure-tone audiometry, highlighting the complementary roles of objective and subjective outcome measures [8, 16, 21].

Novelty of the Present Study

The present study provides additional evidence regarding the relationship between hearing recovery and disease-specific quality of life following tympanoplasty in an Indonesian population. Unlike many previous studies that primarily evaluated hearing outcomes or postoperative quality of life separately, the present study simultaneously assessed audiometric improvement, changes in COMQ-12 scores, correlation analysis, and univariable regression within a prospective longitudinal design. Furthermore, postoperative hearing threshold was significantly associated with postoperative quality of life, whereas hearing gain itself was not associated with patient-reported improvement. These findings highlight the importance of evaluating postoperative functional status rather than relying solely on the magnitude of audiometric improvement, thereby supporting a more patient-centered approach to outcome assessment.

Clinical Perspective

The present findings highlight that successful tympanoplasty should not be evaluated solely by anatomical graft uptake or audiometric improvement. Although significant hearing recovery was achieved, postoperative hearing status rather than hearing gain was more closely associated with patients' disease-specific quality of life. Therefore, incorporating validated patient-reported outcome measures such as the COMQ-12 into routine postoperative follow-up may provide a more comprehensive assessment of surgical success, facilitate patient-centered care, and identify patients who continue to experience substantial functional impairment despite satisfactory audiometric outcomes.

Study Limitations

This study was limited by its relatively small sample size and three-month follow-up period, which may not fully capture long-term hearing stability and quality-of-life outcomes. In addition, several clinical and psychosocial factors that may influence postoperative quality of life, such as Eustachian tube function, smoking status, socioeconomic status, and psychological well-being, were not evaluated. Future multicenter studies with larger cohorts, longer follow-up periods, and comprehensive assessment of clinical and patient-reported outcomes are needed to validate these findings and further clarify the determinants of quality of life after tympanoplasty. Because of the relatively small sample size ($n=40$), additional covariates were not included to avoid model overfitting. Another limitation is that bone-conduction thresholds and air–bone gap closure were not routinely evaluated. Consequently, postoperative hearing improvement was assessed using air-conduction pure-tone averages only, which may not fully characterize functional hearing outcomes after tympanoplasty. Potential variability among surgeons and surgical techniques was not adjusted statistically. Another limitation is the absence of a control group. Consequently, postoperative improvements cannot be completely separated from natural recovery,

regression to the mean, placebo effects, or concurrent treatment. Postoperative COMQ-12 responses may have been influenced by expectation bias because participants were aware they had undergone surgery. Because multiple comparisons were performed across COMQ-12 items, these analyses should be considered exploratory. The findings therefore mainly apply to adults undergoing uncomplicated primary tympanoplasty. Furthermore, a validated minimal clinically important difference (MCID) for the Indonesian version of the COMQ-12 has not yet been established. Therefore, clinical relevance should be interpreted cautiously.

Conclusion

Tympanoplasty significantly improved hearing function and disease-specific quality of life in patients with safe-type chronic otitis media. Significant improvements were observed in hearing thresholds across all evaluated frequencies and in total COMQ-12 scores three months after surgery. Although hearing gain was not significantly associated with improvements in quality of life, postoperative hearing thresholds were significantly associated with postoperative COMQ-12 scores, indicating that the hearing level achieved after surgery is more closely related to patients' perceived recovery than the magnitude of audiometric improvement. These findings support the combined use of pure-tone audiometry and the COMQ-12 as complementary outcome measures for evaluating tympanoplasty, enabling a more comprehensive and patient-centered assessment of surgical success.

Authors' contributions

AJZ: Conceptualization, Methodology, Investigation, Data Collection, Formal Analysis, Writing – Original Draft Preparation. RD: Methodology, Data Collection, Validation, Writing – Review & Editing. TD: Formal Analysis, Investigation, Data Interpretation, Writing – Review & Editing. AS: Investigation, Data Curation, Statistical Analysis, Writing – Review & Editing. All authors have read, approved, and agreed to the final published version of the manuscript.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this study.

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