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ORIGINAL RESEARCH

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The effect of bony obliteration on quality of life after tympano-mastoidectomy surgery: A prospective observational controlled cohort study

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Abstract

Objectives: The study's primary objective was to compare the quality of life (QoL) and external auditory canal (EAC) hygiene among patients who underwent bony mastoid obliteration or meatoplasty after canal wall down (CWD) mastoidectomy.

Methods: A prospective, observational, controlled cohort study was conducted at our tertiary referral university hospital. Twenty-eight patients older than 16 years of age with chronic otitis media who underwent CWD mastoidectomy were included. Two cohorts were followed: CWD mastoidectomy followed by mastoid obliteration (Group 1, $n = 14$) and CWD mastoidectomy followed by meatoplasty (Group 2, $n = 14$). The main outcome measures of total COMBI score (postoperative 6-month QoL) and EAC hygiene were compared between the groups.

Results: The average age of the patients was 36.14 (12. 22) years; 15 (53.6%) were female and 13 (46.4%) were male. There were no differences in demographic variables, preoperative findings, or COMQ-12 (preoperative QoL) scores between groups. The average COMBI score of Group 1 (49.0 [8.66]) was not significantly different from Group 2 (46.79 [7.76]) ($p = .482$). Poor EAC hygiene was observed in eight (57.1%) patients in Group 2 and three (21.4%) patients in Group 1 ($p = .06$). In Group 1, no resorption of graft material was observed in 10 (71.4%) patients, minor resorption was observed in three (21.4%) patients, and significant resorption was observed in one (7.1%) patient. There were no significant differences in audiological findings between groups ($p > .05$).

Conclusion: There were no significant differences regarding short-term postoperative QoL, EAC hygiene, or hearing outcomes between patients who underwent bony mastoid obliteration or meatoplasty after CWD mastoidectomy.

Level of Evidence: 1b (individual prospective cohort study).

KEYWORDS
canal wall down, cholesteatoma, mastoid obliteration, mastoidectomy, quality of life

Meeting information: The abstract of the study was presented at the sixth Congress of European ORL-HNS as an oral presentation (October 29–November 2, 2022, in Milan, Italy).

1 | INTRODUCTION

The primary goals of chronic otitis media (COM) surgery are to eradicate the disease and prevent recidivism.[1] Secondary aims include achieving a dry ear and improving hearing. Clinical research has shown that the rates of residual and recurrent disease are lower after canal wall down (CWD) mastoidectomy than canal wall up (CWU) procedures.[1–3] The advantage of the CWD technique is improved exposition of the surgical field and elimination of the potential spaces where squamous epithelium might be trapped; however, the natural self-cleansing mechanism of the external ear might be disturbed.[4] Therefore, the need for regular cleaning of the epithelial debris and the occurrence of a chronic draining ear due to cavity infection may arise. Furthermore, caloric-induced vertigo and problems with cosmetics and hearing aid fitting have been reported.[2,4,5] Since 2000, mastoid obliteration and reconstruction of the bony external auditory canal (EAC) have become widely used techniques to overcome these problems. Studies have suggested that secondary mastoid obliteration improves patients' quality of life (QoL) by ensuring self-cleaning, dry, and safe ears in patients who previously underwent CWD mastoidectomy with meatoplasty.[6,7] Furthermore, meta-analyses have indicated that mastoid obliteration decreases both recurrent and residual disease.[1,3,8]

Retrospective case series have investigated the effect of secondary obliteration on QoL,[6,7,9,10] and studies have compared CWD mastoidectomy with meatoplasty and CWD mastoidectomy with mastoid obliteration in terms of disease recidivism and cavity problems.[8,11] In this study, we aimed to prospectively compare the effects of both techniques on patients' QoL and external ear hygiene for the first time.

2 | MATERIALS AND METHODS

A single-center, prospective, observational, controlled cohort study was conducted. Our institutional ethics committee approved the study (2020/52). After written informed consent was obtained, 30 patients older than 16 years of age who underwent CWD mastoidectomy for COM were enrolled between April 2019 and September 2021. Patients with a history of ear surgery on the same side in the last year, patients who underwent radical mastoidectomy, patients with previous CWD surgery on the same side, and patients who were not available to complete the QoL questionnaires were not enrolled. Patients who could not be followed up for to first 6 months were excluded from the study. Patients who underwent CWD mastoidectomy with mastoid and epitympanum obliteration were allocated to Group 1, while those who underwent CWD mastoidectomy with meatoplasty were allocated to Group 2. The patients were allocated to groups based on the primary surgeon's preference and whether sufficient bony material was obtained for obliteration.

2.1 | Variables and primary and secondary outcome measures

Demographic variables (age and gender), preoperative findings (disease side, location of retraction pocket, presence of visible cholesteatoma, and wet ear), preoperative QoL questionnaire (Chronic Otitis Media Questionnaire-12 [COMQ-12]) score, perioperative findings (presence of cholesteatoma, ChOLE classification, Austin–Kartush classification, Middle Ear Risk Index-2021 [MERI-2021]), postoperative 6-month findings (tympanic membrane integrity, EAC hygiene, resorption of obliteration material), postoperative QoL questionnaire (Chronic Otitis Media Benefit Inventory [COMBI]) score, preoperative and postoperative audiological variables (average 0.5–1–2–3-kHz air-conduction [AC] thresholds [$AC_{0.5-3kHz}$], average bone-conduction [BC] thresholds [$BC_{0.5-3kHz}$], air-bone gap [$ABG_{0.5-3kHz}$], 4-kHz BC thresholds, and Word Recognition Score [WRS]) were prospectively recorded. Audiological variables were reported according to the guidelines endorsed by the Hearing Committee of the American Academy of Otolaryngology-Head and Neck Surgery.[12,13] Arithmetic averages of 2 and 4 kHz were used to determine 3 kHz measurements.[14] Scattergrams for reporting hearing outcomes were generated using an online application designed by Stanford University.[15]

Primary outcome measures were total COMBI score (QoL questionnaire), EAC hygiene, and resorption of obliteration material. HK and BP examined all patients with an otomicroscope at 6-month follow-up. EAC hygiene was defined as the volume of debris, cerumen, or crusting in the EAC or mastoid cavity. EAC hygiene was graded as "no accumulation" or "slight accumulation" if the accumulation did not need to be cleaned for optimal tympanic membrane, EAC, or mastoid cavity examination and "large accumulation" if cleaning was necessary for optimal examination. The grade of resorption of obliteration material was qualitatively measured exclusively in Group 1; "no resorption" indicated that the posterior–superior wall of the EAC appeared natural and there was no impression that CWD surgery had been performed (the facial ridge was not visible), "minor resorption" indicated that the posterior–superior wall of the EAC was slightly deepened according to the posterior tympanic annulus and facial ridge, and "significant resorption" indicated that the obliteration material was considerably resorbed and the posterior–superior wall of the EAC was deepened as if classical CWD surgery had been performed (the facial ridge is prominent). Audiological variables were determined as secondary outcome measures.

2.2 | ChOLE classification and Middle Ear Risk Index-2021

ChOLE classification was proposed in 2019 to classify patients with cholesteatoma to record and report their surgical findings in a standardized manner.[16] In the classification, "Ch" represents the extent of the disease, "O" represents the status of the ossicular chain at the end of the operation, "L" represents the life-threatening complications, and "E" represents the Eustachian tube function and mastoid ventilation. The stage of the disease was determined based on the sum of all sub-ChOLE scores.

The MERI was used to predict the success of the hearing reconstruction.[17] Higher MERI scores predict poorer hearing outcomes.

The index was recently developed as a smartphone application, "MERI-TRP" (developed by Dr. Uz and Dr. Kartush, Orl.ist, 2021), using data from a study published by Judd et al. in 2020.[18] The surgery type was added in the updated version (MERI-2021), and granulation tissue and middle ear effusion were considered separately and scored in more detail.

We used ChOLE classification and MERI-2021 to assess the homogenization of our cohorts and report the extent of the disease in a standardized manner.

2.3 | Quality of life questionnaires (COMQ-12 and COMBI)

The COMQ-12 is a static questionnaire composed of 12 questions assessing symptom severity, the impact of symptoms on daily life activity, and patient use of healthcare services. The answers are scaled from 0 (no impact) to 5 (the worst impact). Higher COMQ-12 scores indicate lower QoL. All patients were asked to complete the COMQ-12 on the day before the surgery to evaluate the homogeneity of both groups' QoL scores. The COMBI is a dynamic tool that was developed based on questions from the COMQ-12. It assesses changes in symptom severity and their impact on daily life activity and patient use of healthcare services. The answers are scaled from 1 (much worse) to 5 (much better). In contrast with the COMQ-12, higher COMBI scores indicate better QoL. All patients were instructed to complete the COMBI questionnaire at the 6-month follow-up.

We previously translated both questionnaires into the Turkish language and validated their use in Turkish-speaking individuals.[19,20]

2.4 | Surgical techniques

2.4.1 | CWD mastoidectomy with meatoplasty

First, tragal cartilage with perichondrium and temporal muscle fascia grafts were harvested. Attico-antrostomy was then performed by removing the mastoid cortex, mastoid air cells, and posterior–superior bony EAC through a postauricular approach. The debris, matrix, and peri-matrix of the cholesteatoma were removed with the diseased mucosa. Ossicular chain reconstruction was performed accordingly. Next, underlay repair of the tympanic membrane was performed using tragal cartilage and a part of the temporal muscle facia. Radial incisions of Koerner's flap were extended posteriorly. The part of the conchal cartilage at the entrance of the EAC was then excised. Koerner's flap was stitched to the posterior edge of the retroauricular incision covering the bared mastoid cavity. The rest of the temporal fascia graft was placed under the tympanomeatal and Koerner's flap to cover all the bared bone. Gelfoams were placed, and incisions were sutured. Finally, the classical mastoid bandage was placed.

2.4.2 | CWD mastoidectomy with mastoid and epitympanum obliteration

Bone chips were gathered from the mastoid cortex using a chisel and hammer after harvesting tragal cartilage and temporal muscle facia grafts. Bone dust was collected from the mastoid cortex using a cutting burr and a special filter. Opening of the mastoid air cells was avoided to reduce the risk of residual disease. After CWD mastoidectomy, the mastoid and epitympanic cavity were first obliterated with bone chips. Then, bone dust was placed on the bone chips to smooth the surface and raise the level of obliteration to the natural EAC level. Ossicular chain reconstruction and tympanic membrane repair were then performed. Bared bony grafts were entirely covered with temporal muscle fascia grafts. Meatoplasty was not performed. Gelfoams were placed, and incisions were sutured. Finally, the classical mastoid bandage was placed. The obliteration technique is shown in Figure 1.

2.4.3 | Statistical analysis

Power analysis was performed using G*Power (University of Dusseldorf, Dusseldorf). To achieve a power of 0.80 with a type 1 error of 5%, the required sample size for each group was 14, while the expected COMBI score difference between the groups was 5.

The Shapiro–Wilk test and Q–Q normality curves were used to assess the normality of the continuous variables. Data were presented as mean (standard deviation) or median (first to the third quartile) based on the distribution pattern. Normally distributed data were compared using Student's *t*-test for between-group comparison and the paired *t*-test for within-group comparison. The Mann–Whitney *U* test (between-group) and Wilcoxon signed-rank test (within-group) were used for nonnormally distributed data. Categorical variables are presented as numbers (%). Chi-square crosstabs were used for between-group comparisons; however, Fisher's exact test was performed when more than 25% of the cells had an expected count of less than 5.

SPSS Statistics for Windows version 26.0. (IBM Corp., Armonk, NY) was used for data analysis. A p-value <.05 was considered statistically significant for all analyses.

This study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.[21]

3 | RESULTS

3.1 | Demographic data and preoperative and perioperative findings

A total of 30 patients were enrolled in the study, and they were equally allocated to groups ($n = 15$ each). One patient from each group was excluded for a lack of followed-up data. The average age of the patients was 36.14 (12.22, range: 17–60) years. Fifteen (53.6%)

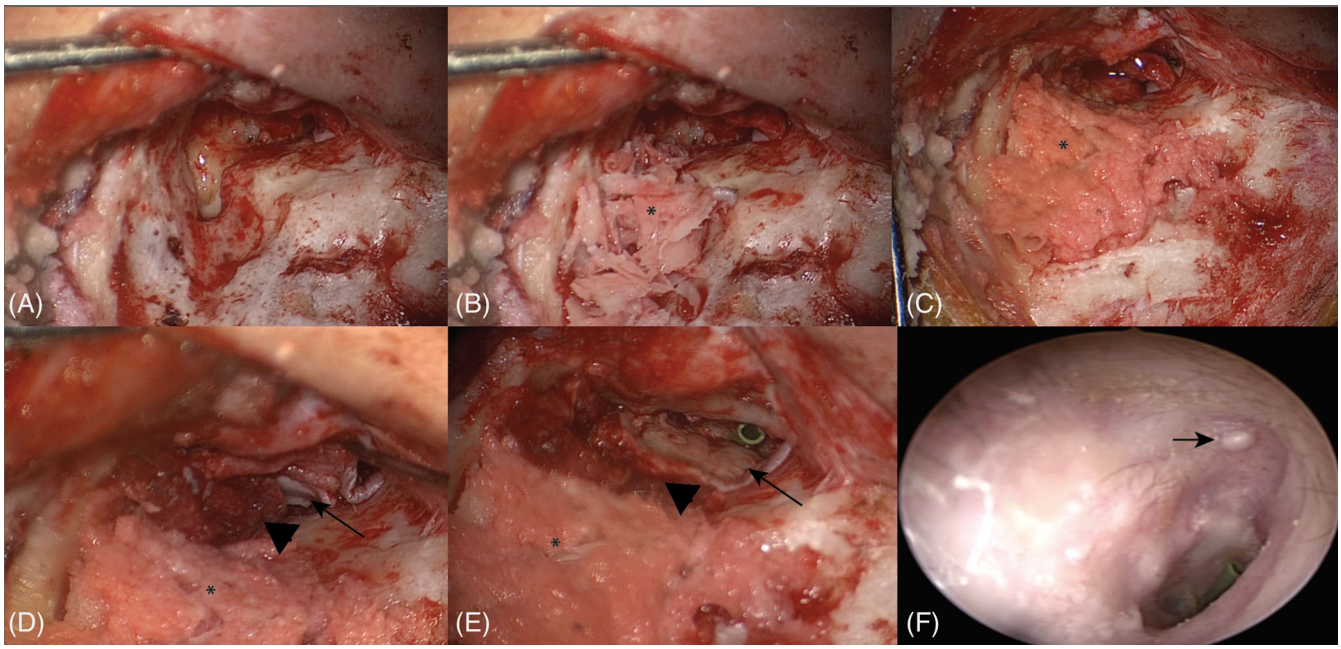

FIGURE 1 Right ear. Bony mastoid obliteration with bone chips and bone dust. (A) Canal wall down mastoidectomy, appearance after disease eradication. (B) Obliteration with bone chips. Star (*) is showing bone chips. (C) Surface smoothing and raising the level of obliteration to the natural EAC level with bone dust. Star (*) is showing bone dust. (D) Underlay tympanoplasty with tragal cartilage (arrow) and temporal muscle fascia (arrowhead) grafts. (E) Appearance at the end of surgery. Tympanomeatal flap (arrow), temporal muscle fascia (arrowhead), bone dust (star). (F) Endoscopic external auditory canal (EAC) and tympanic membrane appearance at the postoperative 6-month. Arrow is showing a small cholesteatoma pearl at the superior EAC.

patients were female, while 13 (46.4%) were male. The comparison of demographic data and preoperative and perioperative findings between groups is presented in Table 1. No variable was significantly different between the two groups; however, MERI-2021 scores were an average of 2.78 points higher in Group 2 compared with Group 1 ($p = .003$).

3.2 | Postoperative 6-month findings and quality of life

No residual or recurrent disease was noted in either group at the 6-month follow-up. All patients had a dry and safe EAC or mastoid cavity. Only one patient from Group 1 experienced dry tympanic membrane perforation encompassing one-quarter of the drum, and the other 27 patients had an intact tympanic membrane. However, minor problems were noted in seven patients; mild atelectasis with well-defined margins and no accumulation of debris was observed in five patients, a small area of myringitis in two patients, and a small EAC cholesteatoma pearl in two patients.

There was no significant difference in tympanic membrane integrity between the groups. However, 35.7% more patients had some degree of debris, cerumen, or crusting accumulation in the EAC in Group 2 compared with Group 1, although the difference was not statistically significant ($p = .06$). Data on tympanic membrane integrity, EAC hygiene, and the resorption of obliteration material are presented in Table 2.

The average COMBI score in Group 1 (49.0 [8.66]) was 2.21 points (95% confidence interval [CI]: −4.17–8.6) higher than in Group 2 (46.79 [7.76]); however, the difference was not statistically significant ($t[26] = 0.713$; $p = .482$).

3.3 | Audiological variables

There were no differences between the groups regarding preoperative $AC_{0.5–3kHz}$, $BC_{0.5–3kHz}$, 4-kHz BC threshold, or WRS. However, the average $ABG_{0.5–3kHz}$ was 8.44 dB (95% CI: 1.48–15.40) higher in Group 2 compared with Group 1 ($p = .019$). Furthermore, no differences in any postoperative audiological variables were observed between the groups, and there were no significant differences in any audiological variables between preoperative and postoperative measurements in both groups. Audiological data are presented in Table 3. Scattergrams showing preoperative and postoperative $AC_{0.5–3kHz}$ thresholds and WRS for Group 1 and Group 2 are presented in Figures 2 and 3, respectively.

4 | DISCUSSION

4.1 | Impact of bony mastoid and epitympanum obliteration on quality of life

We prospectively compared postoperative QoL scores between the two groups. The average COMBI scores of both groups in this study

TABLE 1 Comparison of demographics, preoperative and perioperative findings between groups.

	Group 1 ($n = 14$)	Group 2 ($n = 14$)	p value
Age[a]	36.29 (15.09)	36 (9.08)	.071
Gender (male)	6 (42.9%)	7 (50%)	1
Preoperative			
Disease side (right)	8 (57.1%)	6 (42.9%)	.706
Place of retraction pocket			
Pars flaccida	7 (50%)	4 (28.6%)	.681
Pars tensa	2 (14.3%)	3 (21.4%)	
Both	5 (35.7%)	6 (42.9%)	
External auditory canal	0 (0%)	1 (7.1%)	
Physical examination			
Retraction pocket with visible cholesteatoma	8 (57.1%)	6 (42.9%)	.706
Retraction pocket without visible cholesteatoma	6 (42.9%)	7 (50%)	
Wet ear	3 (21.4%)	3 (21.4%)	1
Perioperative			
Cholesteatoma	10 (71.4%)	8 (57.1%)	0.586
Retraction pocket without cholesteatoma	4 (28.6%)	4 (28.6%)	
Granulation/infection	0 (0%)	2 (14.3%)	
Labyrinthine fistula	1 (7.1%)	2 (14.3%)	1
ChOLE classification (only for patients with cholesteatoma)			
Stage 1	1 (10%)	0 (0%)	1
Stage 2	8 (80%)	7 (87.5%)	
Stage 3	1 (10%)	1 (12.5%)	
Austin–Kartush classification			
M+I+S+	4 (28.6%)	1 (7.1%)	.076
M+S+	4 (28.6%)	3 (21.4%)	
M+S−	1 (7.1%)	0 (0%)	
M−S+	4 (28.6%)	2 (14.3%)	
M−S−	1 (7.1%)	7 (50%)	
M, I head fixation	0 (0%)	1 (7.1%)	
Stapes fixation	0 (0%)	0 (0%)	
MERI-2021[a]	9.43 (1.95)	12.21 (2.49)	.003*
COMQ-12[a]	30.07 (12.34)	32.50 (10.97)	.587
Ossicular chain reconstruction			
At same stage	10 (71.4%)	8 (57.1%)	.695
Second look	0 (0%)	3 (21.4%)	
No need	4 (28.6%)	3 (21.4%)	

Note: Chi-square and Fisher's exact test were used for comparing other variables. Data were presented as number (%).

Abbreviations: −, absent; +, present; COMQ-12, Chronic Otitis Media Questionnaire-12; I, incus; M, malleus; MERI-2021, Middle Ear Risk Index-2021; S, stapes.

[a]Student's t-test was used for comparing continuous variables. Data were presented as mean (standard deviation).

*Statistical significance was reached ($p < .05$).

were similar to the average scores of patients who underwent successful COM surgery in our previous work.[19] Furthermore, with a cut-off value of 38.5, the COMBI questionnaire results revealed a significant improvement in the QoL after COM surgery with 87% sensitivity and 93% specificity.[22] Therefore, in this study, we observed significant improvements in the QoL in both groups. Although the COMBI scores in Group 1 were 2.21 points higher than in Group 2, the difference was not significant. We evaluated the 6-month postoperative period during which patients attended frequent check-ups, routine EAC care was performed, and patients were instructed not to allow water in the EAC. A dry and safe EAC was achieved in 100% of the patients in this study. Therefore, significant differences in QoL scores between groups were not observed. Long-term differences in the QoL can be demonstrated using a questionnaire specific to mastoid cavity problems.

Kurien et al.[7] achieved more improvement in QoL with secondary mastoid cavity obliteration than with primary obliteration. The authors interpreted this difference as a result of the patient group who underwent secondary obliteration consisting of patients suffering from chronic mastoid misery and the effect of dramatic improvement in the postoperative QoL on these patients.[7] Other studies also indicate that secondary obliteration improves the QoL.[6,9,23] The improvement in QoL with secondary obliteration can be directly attributed to the obliteration procedure; however, with primary obliteration, the improvement can be attributed primarily to the mastoidectomy procedure, which results in the eradication of the disease. In our study, the improvement in the QoL of both groups was primarily attributed to the eradication of COM disease and the achievement of a healthy, dry ear. We aimed to evaluate whether the elimination of problems caused by an open mastoid cavity resulted in additional improvements in the QoL. Although many otolaryngologists advocate the contribution of mastoid obliteration to the QoL,[4–8,10] our study failed to reveal such a difference in the early postoperative period from the patients' point of view. In another study comparing the QoL between two patient groups who underwent CWU mastoidectomy and CWD mastoidectomy with obliteration, both techniques were shown to improve QoL; however, no significant difference was found between the two techniques. Furthermore, there was no difference in ear discharge, drug use, effects of COM on life habits, or residual hearing loss in the postoperative period.[24] However, because patients with nonobliterated CWD mastoidectomy were not included in the study, it is difficult to comment on the effect of obliteration alone on QoL scores.

In our study, EAC hygiene, resorption of obliteration material due to infection, and undesired healing of the mastoid cavity were evaluated objectively. The rate of debris, cerumen, or crusting accumulation in the cavity was 57.1% in the Group 2 and 21.4% in the Group 1; however, this difference was not statistically significant due to the small number of patients included in the study for this statistical analysis. In addition, only one of 14 (7.1%) patients who underwent obliteration had significant resorption of obliteration material due to infection of the material. However, this patient did not require additional intervention, and no retraction pocket formation was observed that could not clear itself. In three (21.4%) patients, minor resorption

TABLE 2 Comparison of postoperative sixth month findings between groups.[a]

	Group 1 ($n = 14$)	Group 2 ($n = 14$)	p value
Tympanic membrane			
Intact	13 (92.9%)	14 (100%)	1
Perforation	1 (7.1%)	0 (0%)	
EAC hygiene			
No accumulation	11 (78.6%)	6 (42.9%)	.06
Slight to large accumulation	3 (21.4%)	8 (57.1%)	
Resorption of obliteration material			
No	10 (71.4%)		
Minor	3 (21.4%)		
Significant	1 (7.1%)		

Abbreviation: EAC, external auditory canal.
[a]Fisher's exact test was used. Data were presented as number (%).

TABLE 3 Comparisons of audiological variables.

	Preoperative	Postoperative 6th month	p value
Group 1 ($n = 14$)			
$AC_{0.5-1-2-3kHz}$ (dB)[a]	38.39 (17.87)	34.78 (19.83)	.265
$BC_{0.5-1-2-3kHz}$ (dB)[a]	14.55 (13.46)	13.10 (11.03)	.545
ABG (dB)[a]	23.84 (9.74)	21.68 (11.9)	.463
WRS (%)[b]	88 (84–93)	88 (83–96)	.557
BC_{4kHz} (dB)[b]	15 (8.75–50)	27.5 (10–40)	.422
Group 2 ($n = 14$)			
$AC_{0.5-1-2-3kHz}$ (dB)[a]	47.41 (14.31)	41.93 (15.28)	.219
$BC_{0.5-1-2-3kHz}$ (dB)[a]	15.13 (10.84)	17.57 (11.82)	.498
ABG (dB)[a]	32.28 (8.11)	24.36 (13.61)	.052
WRS (%)[b]	88 (83–92)	88 (87–92)	.432
BC_{4kHz} (dB)[b]	17.5 (10–36.25)	20 (14.25–35)	.477

Abbreviations: ABG, air bone gap; AC, air conduction; BC, bone conduction; dB, decibel; kHz, kilo Hertz; WRS, Word Recognition Score.
[a]Paired sample t test was used. Data were presented as mean (standard deviation).
[b]Wilcoxon signed rank test was used. Data were presented as median (first to third quartile).

did not cause any problems. This may have occurred due to the small amount of resorption or insufficient use of the obliteration material. The remaining 10 (71.4%) patients had completely natural-appearing EACs.

Bernardeschi et al.[23] stated that autologous grafts cause surgical site morbidity and undergo resorption over time. In addition, they mentioned the risk of synthetic graft infection and stated that they instead prefer to use bioactive glass s53p3, which has antibacterial properties.[23] However, we do not believe that harvesting bone chips and dust from the mastoid cortex contributes to morbidity. In addition, the high rate of natural-appearing EACs in Group 1 in our study suggests that the resorption of these autologous bone grafts is low. However, a 6-month period may be too early to make this conclusion. Bacciu et al.[25] argued that attic lateral wall reconstruction with bone dust provides good long-term stability. They demonstrated that total resorption was only 1.4% and partial resorption was 4.4% following the procedure. In another study, it was reported that obliteration with bone dust after CWD mastoidectomy provided a physiological appearance of the EAC at a rate of 95.8% after 5 years. Therefore, the authors concluded that autologous bone grafts are not resorbed in the long term.[26] Furthermore, in a randomized controlled clinical trial using bone dust and bioactive glass granules, no difference was found between the two groups in their achievement of a dry, healthy, and natural-appearing EAC 1 year after the procedure. Furthermore, no difference was observed in postoperative QoL between the groups.[27] The authors mentioned that the 270 US dollars per milliliter of bioactive glass granules increased the surgery cost.[27]

4.2 | Impact of bony mastoid and epitympanum obliteration on cholesteatoma recidivism

No recurrent or residual COM was found in either group at the 6-month follow-up in our study. Mishiro et al.[28] suggested that assessing recurrent cholesteatoma in less than 2 years is not clinically

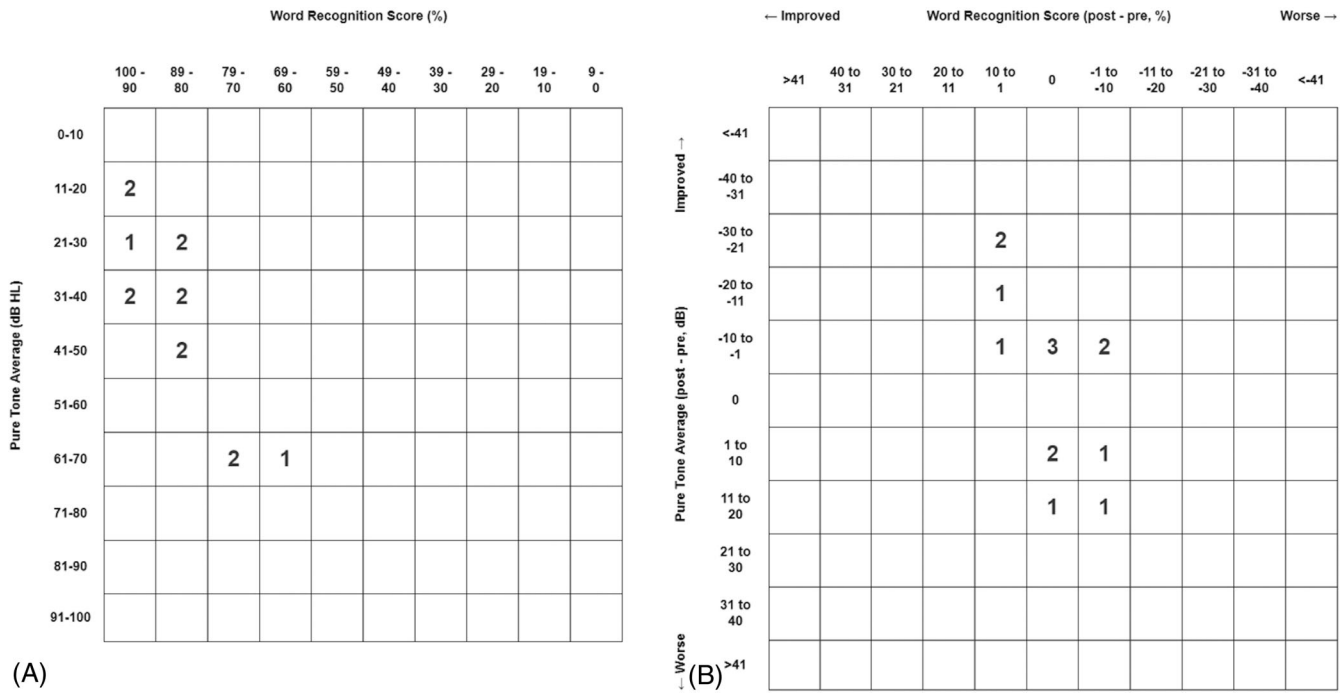

FIGURE 2 Scattergrams of pure tone averages and Word Recognition Scores for Group 1. (A) Preoperative and (B) postoperative 6-month.

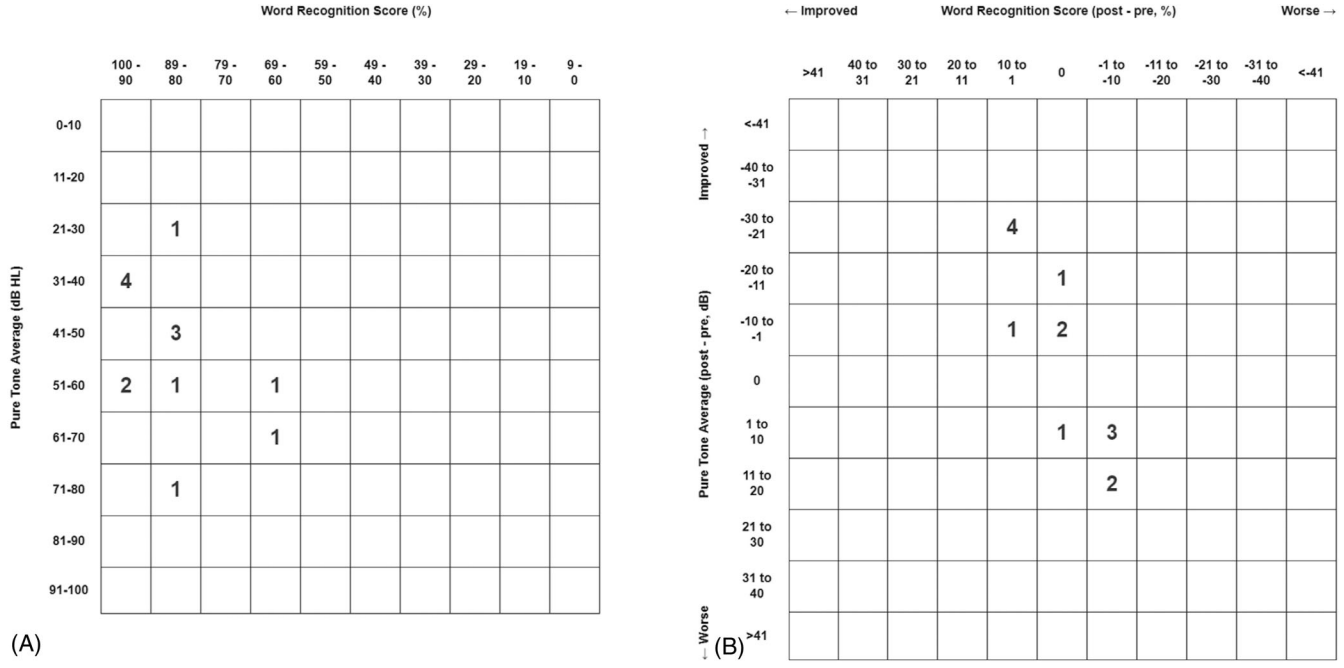

FIGURE 3 Scattergrams of pure tone averages and Word Recognition Scores for Group 2. (A) Preoperative and (B) postoperative 6-month.

significant; therefore, cholesteatoma recidivism was not one of our study's primary outcome variables.

In a recently published retrospective cohort study of 337 cases, the recurrent and residual cholesteatoma rates at 5 years were 4.4% and 3.2%, respectively, in the obliteration group, 21.2% and 11.7% in the CWU mastoidectomy group, and 8.5% and 9.4% in the CWD mastoidectomy group.[8] Similarly, in a meta-analysis including 13 studies, recurrent and residual cholesteatoma rates were 4.6% and 5.4%, respectively, in patients with obliterated mastoidectomy cavities.[1] While recurrence was most common in the tympanic cavity in the obliteration group, it was observed in the tympanic cavity and epitympanum in the CWU mastoidectomy group and the epitympanum and mastoid cavity in the CWD mastoidectomy group.[8] The authors commented that recurrent cholesteatoma was less common in the

obliteration group as there was no space for the epithelium to retract. This idea is supported by the fact that recurrence was mostly occurred in the tympanic cavity in the obliteration group.[8] In addition, the results of an animal study indicated that the inflammatory response to the obliteration material can prevent the growth of a residual cholesteatoma.[29]

4.3 | Impact of bony mastoid and epitympanum obliteration on hearing results

The groups were not significantly different regarding preoperative or postoperative audiological variables; therefore, no effects of the obliteration technique on hearing results were demonstrated. Other authors also failed to demonstrate an effect of obliteration on hearing results.[5,6,8] In contrast, some authors reported successful hearing results in patients who underwent obliteration procedures after mastoidectomy.[23,27,30,31] However, none of the studies compared the obliterated patients with a nonobliterated group; therefore, it is difficult to attribute hearing improvements to obliteration alone. In addition, most of the studies had a retrospective design and did not refer consistently to the confounding factors that might have affected the hearing results.

Theoretically, mastoid obliteration improves middle ear aeration by increasing the height of the facial prominence, resulting in improved hearing gain. However, our study and the literature data do not yet support this hypothesis. Some studies have emphasized the functional contributions of mastoid cavity obliteration from a different perspective, reporting that an obliterated mastoid cavity produces acoustic properties closer to the natural EAC compared with a cavity that is left open.[32,33]

4.4 | Strengths and limitations

Because our study was prospective in design, the data reliability was high. In addition, the required sample size was calculated according to the primary outcome variable (COMBI scores). As our study was not an experimental clinical trial, randomization was not performed to allocate patients into groups, which may have resulted in heterogeneity. Instead, we used a disease classification system and compared preoperative findings, including preoperative QoL scores, between the groups to overcome heterogeneity. The lack of difference in most preoperative variables was one of the strengths of our study. However, the differences in preoperative MERI-21 scores and $ABG_{0.5-3kHz}$ between the groups might have influenced the outcomes. Finally, our study was the first to prospectively compare short-term QoL between obliterated and nonobliterated CWD mastoidectomy patients using a disease-specific surgical outcome assessment tool.

Another limitation of our study is the short follow-up period. However, because the primary aim of the study was to evaluate the short-term QoL, the 6-month follow-up period was determined to be appropriate. Long-term follow-up of our cohort continues to evaluate cholesteatoma recidivism. Furthermore, HK and BP, who performed postoperative evaluations, were not blinded to the knowledge of the surgical procedures, which might have introduced bias to the assessments, especially subjective variables, such as EAC hygiene and the resorption of the obliteration material.

5 | CONCLUSIONS

Our study failed to demonstrate the positive effect of obliteration on QoL and EAC hygiene, and no effect of obliteration on hearing results was demonstrated.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, HK, upon reasonable request.

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