Which technique is better for cholesteatoma surgery?

M. Deniz¹, C. Uslu², Ç. Koldaş³ and B. Deniz⁴

¹Department of Otorhinolaryngology, Namık Kemal University, Medical Faculty, Tekirdağ, Turkey; ²Department of Otorhinolaryngology, Medical Faculty, Medipol University, Fatih, Istanbul, Turkey; ³Department of Otorhinolaryngology, Haydarpaşa Numune Education and Research Hospital, Kadıköy, Istanbul, Turkey; ⁴Faculty of Education, Boğaziçi University, Bebek, Istanbul, Turkey

Key-words. Otitis media; cholesteatoma; mastoidectomy; recurrence

Abstract. Which technique is better for cholesteatoma surgery? Objective: The objective of this study was to evaluate the long-term surgical outcomes and recurrence rates of three surgical techniques that are commonly used for cholesteatoma.

Patients and methods: The hospital records of 132 patients with primary cholesteatoma who underwent surgery between January 1996 and December 2006 were evaluated retrospectively. Twelve cases had bilateral disease, and a total of 144 ears were treated. The patients were divided into three groups according to surgical technique: modified radical mastoidectomy (MRM) (n=48 ears), radical mastoidectomy (RM) (n=42 ears), and intact canal wall mastoidectomy (ICWM) (n=54 ears). MRM and RM procedures are canal wall down (CWD) techniques, whereas the ICWM procedure is a canal wall up (CWU) technique. Postoperatively, all patients were followed up yearly for at least 6 years. The otomicroscopic features, cholesteatoma extension, surgical findings, and recurrence rates were compared in the groups.

Results: Preoperative otomicroscopic examination showed attic retraction or perforation in 32% of the cases and central perforation in 11%. There was a higher cholesteatoma recurrence rate in the ICWM group than in the MRM and RM groups (p<0.05), but there was also better hearing gain in the ICWM group (p<0.05).

Conclusion: There are several surgical techniques for eradicating cholesteatoma. Our study found that CWD procedures (RM, MRM) were more effective for the eradication of cholesteatoma, but hearing gain was better when a CWU technique was used. The choice of surgical technique should be individually tailored based on the pre-operative imaging and hearing examination findings.
cavity, eustachian tube, labyrinth, middle fossa, and mesotympanum), and preoperative hearing levels. A ‘second look’ operation is sometimes needed when a canal wall up (CWU) technique is used to ensure that there is no residual disease within the mastoid cavity or the middle ear, and this is usually performed electively six months to approximately one year after the primary surgery. An increasing number of surgeons are using magnetic resonance imaging (MRI) for postoperative evaluation rather than a second look operation when hearing is sufficient. A canal wall down (CWD) procedure is appropriate for patients who have problems with compliance with surgical aftercare due to personal, social, or geographical conditions. The majority of patients achieve a dry, self-cleaning mastoid cavity after CWD procedures.

There are two main approaches to the surgical management of cholesteatoma. Some otological clinics advocate CWU procedures, while others offer CWD procedures. Although some studies report recurrence rates for both CWD and CWU surgeries, more long-term results data are needed. This is quite important for otolaryngologists because the surgical management of cholesteatoma is a day-in/day-out procedure in ENT surgery. Thoughtful reflection on the use of well known surgical procedures is just as important as investigating new techniques. Accordingly, this study retrospectively analyzed the advantages and disadvantages of three surgical techniques that are commonly used for cholesteatoma.

Material and methods

The hospital records of 132 patients who underwent surgery for primary cholesteatoma between January 1996 and December 2006 at Haydarpaşa Numune Education and Research Hospital were evaluated retrospectively. The study included 63 women and 69 men with a mean age of 41 years (range, 18-72 years). Twelve patients had bilateral disease, so a total of 144 ears were treated surgically. Children younger than 18 years were excluded from the study; notably, postoperative results are often unsatisfactory in this population because of the high rate of cholesteatoma recurrence in children.

In our clinic, CWD mastoidectomy is used for all large cholesteatomas, whereas CWU procedures are usually performed in patients with small cholesteatomas. The standard of care in our institution includes a visit the first week after the operation to remove sutures and packing material, an additional visit at 3-4 weeks for review and debridement, and a final visit the second month after surgery. These patients were asked to visit our clinic yearly after their operation, and all patients were followed up for at least 6 years postoperatively. Every follow-up visit included otomicroscopic examination and audiometric and radiologic investigations (temporal bone HRCT and diffusion MRI).

Patients were divided into 3 groups according to the surgical technique: modified radical mastoidectomy (MRM), radical mastoidectomy (RM), and intact canal wall mastoidectomy (ICWM). The MRM and RM procedures are called CWD techniques, and the ICWM procedure is called a CWU technique. In all cases, a post-auricular approach was performed using a ‘front to back’ technique. We tried to pay meticulous attention to fully clear the disease and totally remove the affected mastoid air cells. In the CWD techniques (MRM and RM), the surgeon removed the remnants of the posterior canal wall, and in the CWU technique (ICWM), the wall was saved or reconstructed. For the CWD technique, the tip of the mastoid process was removed and the hypotympanum, supratubal area, and sinus tympani were examined. The widened mastoid bowl was obliterated using 4 periosteal flaps based anteriorly, posteriorly, superiorly, and inferiorly. Continuous serum physiologic irrigation was performed to remove bone debris and to prevent thermal damage to the cochlea, vestibule, and facial nerve. Exploration of the tegmen, sinus, and vertical facial nerve is routine in our institution. The autologous temporalis muscle fascia was used for myringoplasty.

Cholesteatoma extension was described based on intraoperative involvement of the attic, antrum, mastoid cavity, eustachian tube, labyrinth, middle fossa, and mesotympanum. The functional hearing results were calculated according to the guidelines of the Committee on Hearing and Equilibrium of the American Academy of Otolaryngology Head and Neck Surgery (AAO-HNS). Air bone gaps (ABGs) were calculated from the air conduction (AC) and bone conduction (BC) thresholds. Finally, postoperative hearing gains were calculated by comparing the preoperative (one day before surgery) and the most recent follow-up results.
Cholesteatoma surgery

Statistical data analysis was performed using SPSS for Windows, version 13 (SPSS Inc., Chicago, IL, USA). The Kruskal-Wallis test (KW) was used to compare the groups. Dunn’s multiple comparison test and the Tukey’s range test were used to compare the subgroups, and the chi-square ($\chi^2$) test was used to compare qualitative data. Results were considered significant for $p < 0.05$.

Results

Of the 144 ears with cholesteatoma, 48 were operated with MRM, 42 with RM, and 54 with ICWM. At preoperative otomicroscopic examination, 46 ears (31.94%) had attic retraction or perforation, 19 (13.19%) had total perforation, 31 (21.52%) had subtotal perforation, 22 (15.27%) had marginal perforation, 16 (11.11%) had central perforation, and 10 (6.94%) had both marginal and attic perforation at their tympanic membrane. The percentage of ears with attic retraction or perforation was significantly higher than the percentage of ears with perforation of other areas of the tympanic membrane (KW $= 24.61, p = 0.001$) ($p < 0.05$) (Figure 1).

Regarding the intraoperative extension of disease in all 3 groups, cholesteatoma was more often located in the attic region than in other areas. A total of 41 of 48 ears (85.41%) in the MRM group, 37 of 42 ears (88.09%) in the RM group, and 46 of 54 ears (85.18%) in the ICWM group had cholesteatoma in the attic region (KW $= 19.74, p = 0.003, p < 0.05$). The sites invaded by cholesteatoma in the 3 groups are shown in Table 1.

The incidence of intra-operative findings of ossicular chain status was different in each group. The percentage of ears with erosion or absence of the malleus, incus, or stapes was 52.08% (25/48), 79.16% (38/48), and 10.41% (5/48), respectively, in the MRM group; 64.28% (27/42), 83.33% (35/42), and 16.66% (7/42), respectively, in the RM group; and 59.25% (32/54), 75.92% (41/54), and 12.96% (7/54), respectively, in the ICWM group. In all 3 groups, erosion or absence of the incus was significantly higher than for the other ossicles (KW $= 16.51, p = 0.002, p < 0.05$) (Figure 2).

Postoperative audiometric investigation for a minimum of 6 years showed differences in hearing gain or loss in the 3 groups (Figure 3). One day before primary surgery, a pure-tone audiogram was performed and compared with the last available postoperative audiogram; the audiological evaluations were performed according to the guidelines of the Committee on Hearing and Equilibrium.

![Figure 1](image1.png)

Location of tympanic membrane perforations in the ears with cholesteatoma in this study (n = 144).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Cholesteatoma invasion location in the three treatment groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MRM group</td>
</tr>
<tr>
<td>Attic</td>
<td>41/48 (85.41%)</td>
</tr>
<tr>
<td>Antrum</td>
<td>37/48 (77.08%)</td>
</tr>
<tr>
<td>Mastoid</td>
<td>32/48 (66.66%)</td>
</tr>
<tr>
<td>Middle ear</td>
<td>31/48 (64.58%)</td>
</tr>
<tr>
<td>Labyrinth</td>
<td>4/48 (8.33%)</td>
</tr>
<tr>
<td>Eustachian tube</td>
<td>5/48 (10.41%)</td>
</tr>
</tbody>
</table>

ICWM: intact canal wall mastoidectomy; MRM: modified radical mastoidectomy; RM: radical mastoidectomy.
(29.16%) showed 5-30 dB improvement, 23 (47.91%) showed no change, and 11 (22.91%) worsened by 5-30 dB; in the RM group, 6 of 42 patients (14.28%) showed no change and 36 (85.71%) worsened by 5-30 dB; and in the ICWM group, 23 of 54 patients (42.59%) showed 5-30 dB improvement, 26 (48.14%) showed no change, and 5 (9.25%) worsened by 5-30 dB (Table 2). There was a statistically significant difference between the ICWM group and the other two groups in terms of hearing gain (KW $= 23.02$, $p = 0.034$, $p < 0.05$).

Analysis of cholesteatoma recurrence in the postoperative period (followed-up for at least 6 years after surgery) showed differences in the 3 groups. Based on the otomicroscopic examinations and radiological findings, we decided to perform revision surgeries on some patients. In the MRM group, 11 of 48 ears had revision surgery; 2 (4.16%) showed residual cholesteatoma, and 4 (8.33%) showed recurrence. In the RM group, 7 of 42 ears had revision surgery; 1 (2.38%) showed residual cholesteatoma, and 2 (4.76%) showed recurrence. In the ICWM group, 16 of 54 ears had revision surgery; 5 (9.25%) showed residual cholesteatoma, and 8 (14.81%) showed recurrence (Table 3, Figure 4).

The outcome was based on the percentage of ears with a postoperative air-bone gap (ABG) $< 30$ dB. In the MRM group, 14 of 48 patients
Cholesteatoma surgery

Table 2
Postoperative improvement in the air-bone gap (ABG) according to surgical procedure

<table>
<thead>
<tr>
<th>Group</th>
<th>≤ 10 dB</th>
<th>11-20 dB</th>
<th>21-30 dB</th>
<th>Total ≤ 30 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified radical mastoidectomy (MRM)</td>
<td>3.12%</td>
<td>11.63%</td>
<td>14.41%</td>
<td>29.16%</td>
</tr>
<tr>
<td>Radical mastoidectomy (RM)</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Intact canal wall mastoidectomy (ICWM)</td>
<td>22.64%</td>
<td>18.33%</td>
<td>1.62%</td>
<td>42.59%</td>
</tr>
</tbody>
</table>

Table 3
Residual and recurrent cholesteatoma according to surgical procedure

<table>
<thead>
<tr>
<th>Group</th>
<th>Residual cholesteatoma (%)</th>
<th>Recurrence of cholesteatoma (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified radical mastoidectomy (MRM)</td>
<td>2/48 (4.16%)</td>
<td>4/48 (8.33%)</td>
</tr>
<tr>
<td>Radical mastoidectomy (RM)</td>
<td>1/42 (2.38%)</td>
<td>2/42 (4.76%)</td>
</tr>
<tr>
<td>Intact canal wall mastoidectomy (ICWM)</td>
<td>5/54 (9.25%)</td>
<td>8/54 (14.81%)</td>
</tr>
</tbody>
</table>

Residual cholesteatoma is usually due to insufficient primary resection of the epidermal matrix, and it classically presents with a pearl-like aspect. In this study, residual cholesteatomas were observed most often in the epitympanum (36.42%) followed by the sinus tympani (23.64%). We did not observe residual cholesteatomas in the mastoid cavity, protympanum, hypotympanum, or tympanic orifice of the eustachian tube. Residual cholesteatoma was observed significantly more frequently in the ICWM group than in the other groups (KW = 23.14, p = 0.046, p < 0.05) (Figure 4).

Recurrent cholesteatoma is usually due to attic retraction pockets, especially in ears with pre-operative discharge. Cholesteatoma recurrence was significantly higher in the ICWM group than in the other groups (KW = 26.39, p = 0.0028, p < 0.05).

Discussion

Cholesteatoma is a benign lesion of the middle ear that consists of squamous epithelium and keratin debris. The main goal of cholesteatoma treatment is eradication of the entire cholesteatoma, having a dry middle ear, and hearing restoration as much as possible. In the literature, some authors prefer CWD procedures, while others favor CWU procedures. The cholesteatoma recurrence rates reported after surgery range from 7.6% to 57.0% and are related to the length of follow-up.

Kim et al. retrospectively analyzed 72 cholesteatoma surgeries and reported that 86% of patients with cholesteatoma were successfully treated. They also stated that the average ABGs were satisfactory after CWD surgeries.

Naclerio et al. studied 60 cholesteatoma cases and found that patients with cholesteatoma undergoing intact canal wall tympanoplasty with mastoidectomy need to be re-explored because of high recurrence. They also stated that hearing levels were better after ICWM and that this finding merited further study to reach statistical significance.
surgical observation attributable to insufficient drilling into the facial ridge. We did not observe residual cholesteatoma in the mastoid cavity, protympanum, hypotympanum, or tympanic orifice of the eustachian tube. Therefore, surgeons, especially those with less experience, should pay attention to the epitympanum and sinus tympani in order to prevent residual cholesteatoma. Some authors advise the use of otoendoscopy or an angled mirror to prevent residual disease in the epitympanum and sinus tympani regions in order to obtain clear views of this region and to entirely remove the cholesteatoma.

Although the average ABGs were satisfactory in the MRM group, hearing gain was better in the ICWM group. Nevertheless, the importance of having a dry ear without discharge versus the importance of having excellent hearing should be taken into consideration and should be explained to the patients. Despite the ongoing debate, the results of our study provide strong evidence that a CWU technique results in a higher rate of recurrence. However, according to the patients’ pre-operative data, including the results of otomicroscopic examination and audiometric and radiologic investigations (i.e. temporal bone HRCT and diffusion MRI), the choice of surgical technique should be individually tailored to each patient. If CWU is considered feasible after taking into account the different parameters (especially the extent of the cholesteatoma), this technique may result in less morbidity and a reduced need for post-operative care.

**Conclusion**

There are several surgical techniques that can be used to remove cholesteatoma. This study showed that CWD procedures like RM and MRM are more effective than CWU procedure for eradicating cholesteatoma, but hearing gain is better after CWU. The choice of surgical technique should be tailored to each individual patient based on the pre-operative imaging and hearing examination findings.

**References**

Cholesteatoma surgery


Assist Prof Mahmut Deniz, M.D
Department of Otorhinolaryngology
Namık Kemal University, Medical Faculty
Tekirdağ, Turkey
Tel.: 0090 282 250 51 88
E-mail: drmahmutdeniz@hotmail.com