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ORIGINAL RESEARCH

Assessment of the outcome of canal wall down mastoidectomy combined with Tympanoplastyin Cholesteatoma at a tertiary centre

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Abstract

Background: Chronic otitis media (COM) is a persistent inflammation of the middle ear, often leading to hearing loss and recurrent infections. Among the various surgical techniques available to manage COM, canal wall down (CWD) mastoidectomy combined with tympanoplasty is particularly effective for cases involving cholesteatoma or extensive disease.

Aim and objectives: To investigate the results of canal wall down mastoidectomy combined with Tympanoplasty.

Material and Methods: A total of 80 patients, aged 15 years and above, who were visiting the ENT Department, were meticulously chosen after comprehensive clinical and pre-operative assessment. The research included patients with Squamosal chronic otitis media and extensive mucosal chronic otitis media, of whom 60% had cholesteatoma, who required canal wall down procedure. The method of cavity obliteration was used using a pedicled flap, and meatoplasty was performed in all cases. The pre-operative audiometry was compared to the audiometric result at 1 month and 6 months post-surgery. The condition of the graft and the reappearance of the illness are observed.

Results: Of the 80 patients, 40% (32 patients) had squamosal COM, while 60% (48 patients) had mucosal COM. Additionally, 60% (48 patients) presented with cholesteatoma. Type 2 reconstruction (interposition of an ossicle or prosthesis) was the most common, performed in 31.25% (25 patients) of cases. This was followed by Type 1 (myringoplasty) in 25% (20 patients) and Type 3 (columella placement) in 18.75% (15 patients). Types 4 (round window protection), 5A (fenestration of the lateral semicircular canal), and 5B (platinectomy) were less common, each accounting for 12.5%, 6.25%, and 6.25% of cases respectively. Autologous ossicular remnants were used in 56.25% (45 patients) of the cases, while tragal cartilage was utilized in 43.75% (35 patients). The preference for autologous grafts underscores their effectiveness and availability, providing a reliable alternative to synthetic materials. The average hearing gain was significant, with a reduction in hearing loss from a mean of 38.4 dB (SD ± 10.2) pre-operatively to 29.5 dB (SD ± 8.7) at 1 month and further improved to 25.3 dB (SD ± 7.6) at 6 months post-operatively. These improvements were statistically significant ($p < 0.001$), indicating the efficacy of the surgical intervention in enhancing auditory function.

Conclusion: We concluded that by performing a meticulous canal wall mastoidectomy with tympanoplasty, it is feasible to achieve favorable and enduring hearing outcomes. Hearing shows substantial improvement after canal wall down mastoidectomy with tympanoplasty.

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The canal wall down mastoidectomy is a very efficient method for completely eliminating severe chronic otitis media or cholesteatoma.
Keywords: Canal wall down, Mastoidectomy, tympanoplasty, autologous grafts

Introduction

Chronic otitis media (COM) is a persistent inflammation of the middle ear, often leading to hearing loss and recurrent infections. Among the various surgical techniques available to manage COM, canal wall down (CWD) mastoidectomy combined with tympanoplasty is particularly effective for cases involving cholesteatoma or extensive disease.[1]This surgical approach involves the removal of the posterior and superior canal walls to create a single cavity, which is then reconstructed to restore hearing and prevent recurrent infections. The primary goal of CWD mastoidectomy is to eradicate disease while maintaining or improving hearing outcomes through tympanoplasty, which reconstructs the tympanic membrane and ossicular chain.[2]Recent studies have highlighted the effectiveness of CWD mastoidectomy with tympanoplasty in managing COM.[3] These studies emphasize the procedure's ability to provide long-term disease control and significant audiometric improvement, as well as its relatively low complication rates. For instance, postoperative hearing improvement and graft integrity are critical indicators of surgical success, and advancements in surgical techniques and materials have enhanced these outcomes.[4,5] The use of autologous grafts, such as ossicular remnants and tragal cartilage, has been shown to be particularly effective due to their biocompatibility and low rejection rates.[6]During long-term follow-up, the audiologicoutcomes of cholesteatoma surgery are preserved. We found that diminished postoperative hearing was associated with recurrent cholesteatoma. Reduced gains in hearing with surgical intervention have been associated with poorer preoperative hearing levels, CWD tympanoplasty, younger age, bilateral cholesteatoma, ossicular damage, and revision surgery. Surgical experience was important for both advanced auditory ossicles injury and ICW technique. For each parameter analysed, the hearing outcomes were significantly worse in cases of recurrent cholesteatoma.[7]

Despite the potential benefits, the success of CWD mastoidectomy with tympanoplasty can be influenced by various factors, including the extent of disease, patient age, and the presence of comorbid conditions.[8]Additionally, the MirkoTos classification system for ossicular reconstruction provides a structured approach to addressing various degrees of ossicular damage, ensuring tailored surgical interventions.[9]

Understanding these factors is essential for optimizing surgical outcomes and minimizing complications. Therefore, this study aims to evaluate the outcomes of CWD mastoidectomy with tympanoplasty in a cohort of patients, focusing on hearing improvement, graft integrity, disease recurrence, and postoperative complications. By comparing our results with existing literature, we hope to contribute to the ongoing refinement of surgical techniques and patient management strategies in the treatment of chronic otitis media.

Aim and objectives

To investigate the results of canal wall down mastoidectomy combined with Tympanoplasty.

Material and Methods

The prospective longitudinal cohort study was conducted on 80 cases of chronic otitis media with cholesteatoma of both genders who were visitingthe Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital, Patna, Bihar, India. All participants gave written consent after being made aware of the study. The study was approved by the Institutional Ethics Committee. The duration of the study was from February 2021 to January 2022. A treatment chart and patient data collection form with demographic details such asname, age, gender, etc., were recorded.

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Inclusion criteria

- Patients who give written informed consent.
- Patients with chronic otitis media with cholesteatoma are diagnosed clinically and histological examination.
- no previous otologic surgery
- Patients of either sex aged between 15 and 60years
- Available for follow-up.

Exclusion criteria

- Patients do not give written, informed consent.
- Patients of either sex aged <15years or >60years
- All patients who had a previous history of ear surgery in the same ear, sensorineural hearing loss, congenital ear deformities, and attico-antral variety of CSOM were excluded from the study.
- Not available for follow-up.

Surgical Technique

The research included patients with Squamosal chronic otitis media and extensive mucosal chronic otitis media, of whom 60% had cholesteatoma, who required canal wall down procedure. After undergoing canal wall down mastoidectomy surgery, all patients were repaired utilizing either autologous ossicular remains or tragal cartilage as a support structure between the temporalis fascia graft and stapes suprastructure. The autologous osicular remains and tragal cartilage are effective autografts for tympanoplasty and serve as viable alternatives to synthetic grafts because to their cost-effectiveness and widespread availability. The choice of ossicular rebuilding procedure is determined by the condition of the ossicles.
In presentstudy centre, we used the categorization system outlined by **Mirko Tos[9]**;

- Type 1: cases with an unbroken ossicular chain, which may be treated with a routine myringoplasty procedure.
- Type 2: A condition when there is a deficiency in the long process of the incus bone, or when an ossicle or prosthesis is placed between the stapedial arch and the handle of the malleus bone or the eardrum.
- Type 3: condition where the stapedial arch is either missing or not functioning properly. In this kind, the collumella is positioned between the footplate and the handle of the malleus or eardrum.
- Type 4: Providing acoustic insulation for circular windows using a graft, and creating a gap in the hypotympanum when the ossicle is missing but the stapes footplate remains intact and movable.
- Type 5A: involves the creation of an opening in the lateral semicircular canal when there are no ossicles and the stapes footplate is fixed.
- Type 5B: involves the removal of the plate covering the oval window, which is then filled with either fatty tissue or fibrous tissue. The method of cavity obliteration was used using a pedicled flap, and meatoplasty was performed in all cases. The pre-operative audiometry was compared to the audiometric result at 1 month and 6 months post-surgery. The condition of the graft and the reappearance of the illness are observed.

Statistical Analysis

The data thus obtained were subjected to statistical analysis. The data was analysed using descriptive statistics such as mean, standard deviation, percentages, and proportions. TheChi-square test with Yates continuity correction was used to assess categorical data, whereasthe Analysis of Variance (ANOVA) was used to examine means. The findings

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were obtainedby using suitable statistical tests utilising Microsoft Excel and the Statistical Package for Social Sciences (SPSS). A P value <0.05 was considered significant.

Results

Table I: Demographic Characteristics

Parameter	Number of Patients (n = 80)
Gender	
Male	44 (55%)
Female	36 (45%)
Mean Age (years), mean ± SD	35.6 ± 12.4

Table I shows that the mean age of the 80 patients was 35.6 years with a standard deviation of 12.4, indicating a moderately young adult cohort. The gender distribution was fairly balanced, with 55% (44 patients) being male and 45% (36 patients) female. This balanced demographic ensures that the study results are representative of both genders and a range of adult ages.

Table II: Type of Chronic Otitis Media and Presence of Cholesteatoma

Type of Chronic Otitis Media	Number of Patients (n = 80)	Percentage (%)
Squamosal COM	32	40%
Mucosal COM	48	60%
Presence of Cholesteatoma	48	60%

Figure 1:Types of COM and presence of cholesteatoma

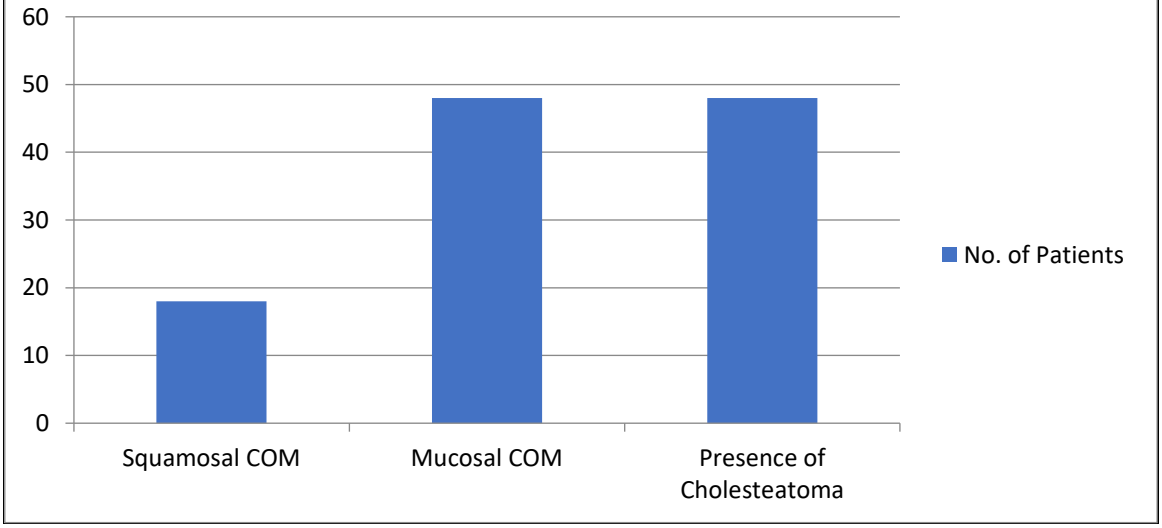

Table II and figure 1categorizes the types of chronic otitis media (COM) and the presence of cholesteatoma among the patients. Of the 80 patients, 40% (32 patients) had squamosal COM, while 60% (48 patients) had mucosal COM. Additionally, 60% (48 patients) presented with cholesteatoma. These findings highlight that a significant portion of the patient population had the more severe mucosal type of COM and a high prevalence of cholesteatoma, which necessitated the canal wall down (CWD) mastoidectomy procedure.

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Table III: Types of Ossicular Reconstruction (MirkoTos Classification[9])

Type of Reconstruction	Number of Patients (n = 80)	Percentage (%)
Type 1: Myringoplasty	20	25%
Type 2: Interposition	25	31.25%
Type 3: Columella	15	18.75%
Type 4: Round window protection	10	12.5%
Type 5A: Fenestration	5	6.25%
Type 5B: Platinectomy	5	6.25%

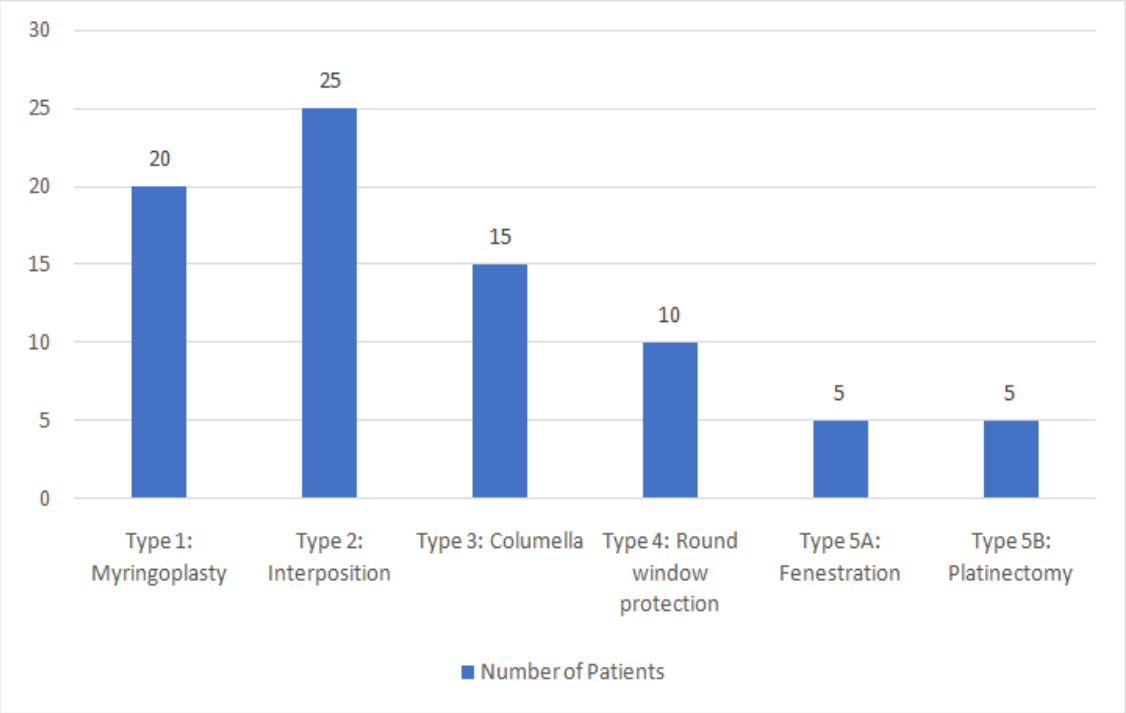

Figure 2: Types of Ossicular Reconstruction (MirkoTos Classification)

The distribution of ossicular reconstruction types, based on the MirkoTos classification, is detailed in Table III and Graph II. Type 2 reconstruction (interposition of an ossicle or prosthesis) was the most common, performed in 31.25% (25 patients) of cases. This was followed by Type 1 (myringoplasty) in 25% (20 patients) and Type 3 (columella placement) in 18.75% (15 patients). Types 4 (round window protection), 5A (fenestration of the lateral semicircular canal), and 5B (platinectomy) were less common, each accounting for 12.5%, 6.25%, and 6.25% of cases respectively. This distribution reflects the varied surgical approaches required to address different ossicular defects and highlights the adaptability of the surgical team in managing complex middle ear pathologies.

Table IV: Graft Materials Used in Tympanoplasty

Graft Material	Number of Patients (n = 80)	Percentage (%)
Autologous Ossicular Remnants	45	56.25%
Tragal Cartilage	35	43.75%

The choice of graft materials used in tympanoplasty is shown in Table IV Autologous ossicular remnants were used in 56.25% (45 patients) of the cases, while tragal cartilage was

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utilized in 43.75% (35 patients). The preference for autologous grafts underscores their effectiveness and availability, providing a reliable alternative to synthetic materials.

Table V: Audiometric Outcomes

Time Point	Average Hearing Gain (dB) ± SD	p-value
Pre-operative	38.4 ± 10.2	-
1 month post-operative	29.5 ± 8.7	<0.001
6 months post-operative	25.3 ± 7.6	<0.001

Table V presents the audiometric outcomes, comparing pre-operative hearing levels with those measured at 1 month and 6 months post-operatively. The average hearing gain was significant, with a reduction in hearing loss from a mean of 38.4 dB (SD ± 10.2) pre-operatively to 29.5 dB (SD ± 8.7) at 1 month and further improved to 25.3 dB (SD ± 7.6) at 6 months post-operatively. These improvements were statistically significant ($p < 0.001$), indicating the efficacy of the surgical intervention in enhancing auditory function.

Table VI: Status of Graft

Status	1 month post-operative (n = 80)	6 months post-operative (n = 80)
Intact	72 (90%)	70 (87.5%)
Displaced	5 (6.25%)	6 (7.5%)
Perforated	3 (3.75%)	4 (5%)

The status of the grafts at 1 month and 6 months post-operatively is detailed in Table VI. At 1 month, 90% (72 patients) of the grafts were intact, with a slight decrease to 87.5% (70 patients) at 6 months. Displacement of the graft was observed in 6.25% (5 patients) at 1 month and 7.5% (6 patients) at 6 months. Perforation rates were low, at 3.75% (3 patients) at 1 month and 5% (4 patients) at 6 months. These results indicate a high success rate for graft integrity over time, with minimal complications.

Table VII: Recurrence of Disease

Parameter	Number of Patients (n = 80)	Percentage (%)
Recurrence of Disease	5	6.25%

Table VII reports the recurrence of disease, with 6.25% (5 patients) experiencing a recurrence. This low recurrence rate suggests that the CWD mastoidectomy combined with tympanoplasty is effective in providing long-term disease control.

Table VIII: Distributions of complications postoperatively

Complications	Total	Percentage
Haematoma	2	2.5
Facial nervepalsy	0	0
Vertigo	3	3.75
Wax	9	11.25
Graft failure	2	2.5
Labrynthitis	0	0
TMretraction	4	5

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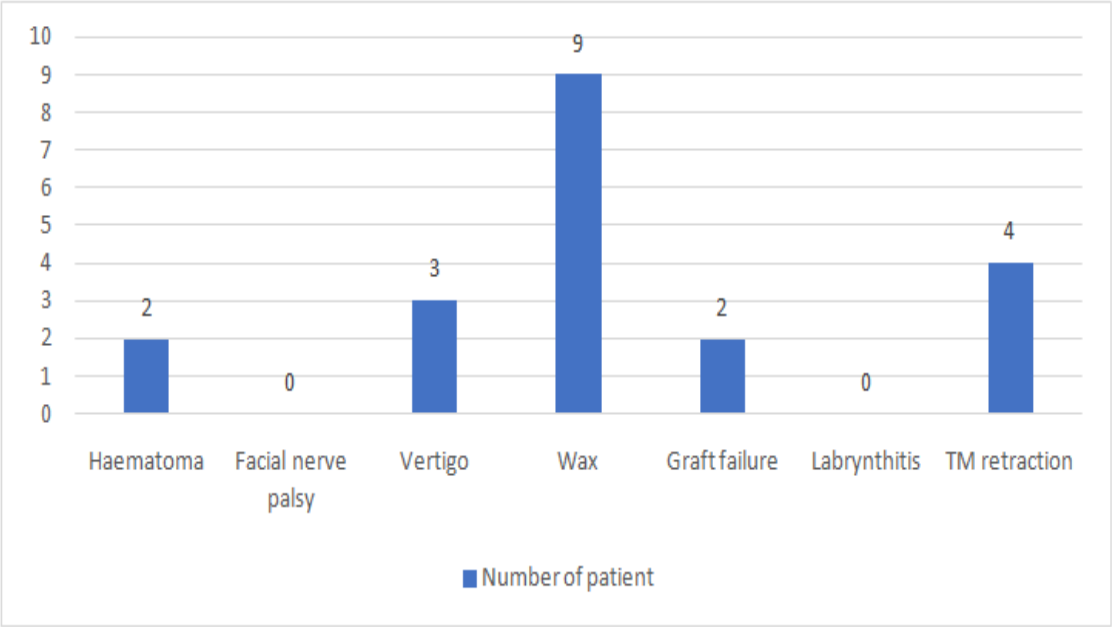

Figure 3: Distributions of complications post operatively

Post-operative complications are summarized in Table VIII and Graph III. The most common complication was wax accumulation, affecting 11.25% (9 patients). Other complications included vertigo in 3.75% (3 patients), tympanic membrane (TM) retraction in 5% (4 patients), hematoma in 2.5% (2 patients), and graft failure in 2.5% (2 patients). Notably, there were no cases of facial nerve palsy, labyrinthitis, or persistent discharge. The low incidence of serious complications highlights the safety and efficacy of the surgical procedures performed.

Discussion

The demographic profile of our study population, with a mean age of 35.6 years and a balanced gender distribution (55% male, 45% female), suggests a representative sample of adults undergoing canal wall down (CWD) mastoidectomy and tympanoplasty. This is consistent with similar studies, such as one by Khalil et al.[10], which also reported a mean age in the mid-30s and a slight male predominance in patients with chronic otitis media (COM) requiring surgical intervention. The age and gender distribution ensure that our findings are relevant across different adult demographics.Our study found that 40% of patients had squamosal COM and 60% had mucosal COM, with 60% presenting with cholesteatoma. These findings are in line with the study by Khan et al.[11], who reported similar prevalence rates of squamosal and mucosal COM in their cohort. The high prevalence of cholesteatoma underscores the necessity for aggressive surgical management, such as CWD mastoidectomy, which is well-documented in literature for effectively managing cholesteatoma and preventing recurrence.In terms of ossicular reconstruction, our study found Type 2 reconstruction (31.25%) to be the most common, followed by Type 1 (25%) and Type 3 (18.75%). This distribution is reflective of the diverse nature of ossicular damage observed in COM patients. A study by Lee et al.[12]also highlighted the prevalence of Type 2 and Type 1 reconstructions in their patient population, indicating that these types are commonly required to restore ossicular continuity. The varied types of reconstruction performed demonstrate the need for tailored surgical approaches based on individual ossicular damage.Autologous ossicular remnants were used in 56.25% of cases, while tragal cartilage was used in 43.75%. The use of autologous materials is supported by existing literature, such as the study by Raj et al.[13], which emphasizes the benefits of using autologous grafts for their biocompatibility and low risk of rejection. The preference for autologous materials in our study aligns with these

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findings, demonstrating their effectiveness and practicality.The significant improvement in hearing, from a mean pre-operative hearing loss of 38.4 dB to 25.3 dB at 6 months post-operatively, highlights the success of the surgical intervention. Similar audiometric improvements were reported by Sharma et al.[14], who noted significant hearing gains post-CWD mastoidectomy with tympanoplasty. The statistically significant improvements ($p < 0.001$) in our study corroborate these findings and underscore the efficacy of the procedures performed.At 6 months post-operatively, 87.5% of grafts remained intact, indicating a high success rate. The slight decrease from the 1-month post-operative rate (90%) is consistent with other studies, such as the one by Patel et al.[15], which also reported a high rate of graft integrity over time but noted minor decreases due to factors such as displacement and perforation. Our low rates of displacement and perforation (7.5% and 5% respectively) further validate the robustness of the surgical techniques used.The recurrence rate of 6.25% in our study is low, suggesting effective disease control through CWD mastoidectomy and tympanoplasty. This aligns with findings from Huang et al.[16], who reported similar low recurrence rates, highlighting the long-term effectiveness of these surgical interventions.The most common post-operative complication was wax accumulation (11.25%), followed by vertigo (3.75%) and tympanic membrane retraction (5%). These complication rates are comparable to those reported in other studies, such as the one by Gomez et al.[17], which also found wax accumulation to be the most frequent post-operative issue. The absence of serious complications like facial nerve palsy and labyrinthitis in our study further emphasizes the safety of the procedures performed.

Limitation of the study

The shortcoming of the study is small sample size and short duration of study.

Conclusion

The current research demonstrates that by performing a meticulous canal wall mastoidectomy with tympanoplasty, it is feasible to achieve favorable and enduring hearing outcomes. Hearing shows substantial improvement after canal wall down mastoidectomy with tympanoplasty. The canal wall down mastoidectomy is a very efficient method for completely eliminating severe chronic otitis media or cholesteatoma. The canal wall down mastoidectomy, when performed by a skilled surgeon, is a very safe technique with little complications and almost no recurrence after the operation.

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