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Original Article

Clinical trial to evaluate the outcome of canal wall up and canal wall down tympanomastoidectomy

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Abstract

Aim: The aim of this study was to evaluate the hearing outcomes of chronic suppurative otitis media surgery. Chronic suppurative otitis media (CSOM) surgery composed of two procedure; canal wall up mastoidectomy (CWU) and canal wall down mastoidectomy (CWD).

Material and Methods: The study included 29 patients with CSOM diagnosis and patients a mean age of 37.02 ± 2.4 years (y). The demographic features (age, gender), clinical features and intraoperative findings of the patients were recorded. Patients' hearing was evaluated with pure tone audiometry (PTA) at 0.5, 1, 2, 4 and 8 kHz and pre-postoperative air bone gap (ABG) difference. Pre- and post-operative air-bone gap (ABG) at 12 months after ossiculoplasty. There were 8 patients who underwent CWD and 21 patients who underwent CWU.

Results: TWhen preoperative and postoperative ABG for the patients are compared, there were statistically significant differences identified at 0.5, 1, 2 and 8 kHz. However, there was no statistically significant difference identified at 4 kHz.

Conclusion: Regardless to the surgical technique, statistically significant levels of hearing gain were provided at 0.5, 1, 2 and 8 kHz; however, there was no hearing gain at 4 kHz after the surgical procedure.

Keywords: Chronic suppurative otitis media; canal wall up mastoidectomy; canal wall down mastoidectomy; hearing thresholds

INTRODUCTION

For treatment of chronic suppurative otitis media (CSOM) with cholesteatoma and/or granulation tissue, the surgical techniques generally used are canal wall up (CWU) and canal wall down (CWD) tympanomastoidectomy (1). The difference between these two techniques is that CWU does not remove the posterior ear canal wall, while the CWD technique removes the posterior ear wall. Both techniques have advantages and disadvantages. However, the common aim with both techniques is to fully clear the disease and obtain good hearing outcomes. The decision about which surgical technique to choose is made according to the spread of the disease, hearing status and patient status. (2,3). With CWD the control of the disease is provided more easily with low residue rates; however, as the ear anatomy is disrupted there may be cosmetic problems and a need for regular doctor check-ups, recurrent cavity infections may occur and quality of life may be negatively affected. While the anatomic structure is not disrupted in CWU, there may be difficulties with full eradication of the disease or recurrence may occur from repeated retraction pouches (4,5). Without regard to surgical technique, it is reported that the disease control rate is 72.1% for patients operated due to chronic otitis media (6). However, surgical success rates vary linked to many factors like the presence and spread of cholesteatoma and surgical technique.

Our aim in this study is to compare the outcomes for patients with chronic otitis media with cholesteatoma and or granulation attending our hospital treated either with CWD or with CWU tympanomastoidectomy.

MATERIAL and METHODS

Patients

Ethical Approval was received from the local ethics committee for this study (2019/168). Patients were 29 cases attending Malatya and Antalya Education and Research Hospital Otolaryngology Clinics with CSOM

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diagnosis. All patients had temporal tomography and pure tone audiogram performed before the operations.

Cases with dead ear and revision, with sensorineural loss, and perilymphatic fistula were excluded from the study. The study included patients operated for the first time, with only conductive-type hearing loss, with no history of ototoxic medication use and with no systemic disease (like diabetes, chronic renal failure, etc.)

Patients characteristics (age, gender), presence of chronic discharge, presence of preoperative vertigo, intraoperative facial nerve status, bone chain integrity, mastoid cell status, antrum mucosa status, presence of cholesteatoma, duration from date of operation to last check-up, hearing reconstruction material chosen (incus, total ossicular replacement prosthesis (TORP), partial ossicular replacement prosthesis (PORP), none), pre-postoperative air bone gap (ABG) difference, graft material chosen for CWU (temporal muscle fascia, cartilage graft), postoperative fascia status (intact, perforated) and disease recurrence or residue status were recorded. There were 8 patients who underwent CWD and 21 patients who underwent CWU.

Surgical Technique

Similar surgical procedures were applied to all patients participating in the study. Surgery was performed under general anesthesia. After postauricular incision, the tympanomeatal flap was elevated. All patients had mastoidectomy procedure performed. If disease was very widespread, posterior canal wall was removed to the facial canal level. When marked attic erosion is present in disease, especially in adults, we perform a CWD technique to avoid disease recurring. Removal and exteriorization of all air cells posterior to the mastoid segment of the facial nerve and the sigmoid sinus is carried out. Removal of sufficient bone from the sinodural angle is also a part of the procedure. In this CWD technique, since the posterior wall of the external auditory canal is removed, the mastoid and the external auditory canal became a common communicating cavity exposed to the outside after surgery. Meatoplasty was performed in all patients with CWD operation. We made CWD cholesteatoma in cases of: contracted mastoid, large epitympanic erosions, severe sensorineural hearing loss.

In a CWU, we made adequate saucerization of the mastoid cavity with complete drilling of the sinodural angle and bony overhang at cavity edges. In the CWU, the posterior canal wall was not removed, the presence of passage from antrum to middle ear and aditus, facial recess and sinus tympani were checked. The bone chain status and mobility were checked. The semicircular canal and facial canal were checked. After disease eradication, hearing reconstruction by incus reposition of with prostheses was performed in the same session if necessary in CWU. Fascia or cartilage graft was inserted. We perform CWU on patients with cholesteatoma in the mastoid cavity and cholesteatoma in patients with highly pneumatized mastoids and minor epitympanic erosion and mesotympanic cholesteatoma.

Hearing Assessment

Patients' hearing was evaluated with pure tone audiometry (PTA) at 0.5, 1, 2, 4 and 8 kHz. The guidelines of American Academy of Committee on Hearing and Equilibrium were taken as basis when evaluating PTA results. Patients had the difference in air-bone gap values on pre and postoperative PTA compared statistically.

Statistical analysis

Statistical analysis of hearing results was performed using the Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS Inc., Chicago, IL, USA). According to the Kolmogorov-Smirnov test, it was found that the data did not have a normal distribution.The pre- and postoperative PTA-ABG results and hearing gains of both groups of patients were compared for specific frequencies with the Wilcoxon signed rank test, and p values <0.05 were considered statistically significant.

RESULTS

The study included 29 patients, with 15 male and 14 female. Mean age was 37.02 ± 2.4 years, with minimum age 15 and maximum age 64. Mean follow-up duration after the operation was 12.6 ± 1.3 months. Preoperatively 17 patients (58.6%) had chronic otorrhea complaint, while 12 patients (41.4%) had no otorrhea. Preoperatively, one patient (3.4%) had dizziness complaint, while 28 patients (96%) did not have dizziness. Preoperatively no patients had facial paralysis.

Table 1. Laboratory and demographic data of positive patients

Age	37.02 ± 2.4 years
Sex	
Male	15 (51.7%)
Female	14 (49.3%)
Application complaints	
Vertigo	1 (3.4%)
Otorrhea	17 (58.6%)
Facial canal	
Intact	27 (93.1)
Nonintact	2 (6.9%)
Mucosa	
Hypertrophy	18 (62.1%)
Polyp	6 (20.7%)
Sclerosis	5 (17.2%)
Cholesteatoma	
Positive	14 (48.3%)
Negative	15 (51.7%)
Hearing reconstruction	
Incus	4 (13.8%)
TORP	2 (6.9%)
PORP	1 (3.4%)
None	22 (75.9%)

Graft material	
Temporal muscle fascia	16 (55.2%)
Cartilage graft	13 (44.8%)
Postoperative fascia status	
intact	19 (79.4%)
nonintact	6 (20.6 %)
Follow-up time	12 ± 1.3 months
Residue	0
Recurrence	6 (20.6%)

Of patients, eight underwent CWD and 21 underwent CWU. In two patients (6.9%) defect was observed in the facial canal intraoperatively. In 27 patients (93.1%), the facial canal was intact. In 19 patients (65.5%), bone chain was complete and mobile, while in 10 patients (34.5%) the bone chain was not intact. In 18 patients (62.1%), the antrum mucosa was hypertrophic, while six patients (20.7%) had antrum mucosa polyp and in five patients (17.2%), the mucosa was sclerotic. Hearing reconstruction was not required in 22 patients (75.9%), while four patients (13.8%) had incus reposition, one patient (3.4%) had PORP and two patients (6.9%) had TORP inserted. Graft material was cartilage graft for 13 patients (44.8%) and fascia graft for 16 patients (55.2%).

Postoperatively, six patients with CWU (20.6%) had perforated graft material and 23 (79.4%) had intact graft material. None of the CWD patients had recurrence or residue observed. Postoperatively no patients had facial paralysis. Regardless of surgical technique in 23 patients (79.3%), full control of disease was provided. Control was provided for 11 of the 15 cholesteatoma chronic otitis patients (74%). Control was provided for 12 of the 14 cholesteatoma-free chronic otitis patients (85.8%) (Table 1).

In 14 patients (48.3%), cholesteatoma was present, while 15 patients (51.7%) had granulation tissue present. Of 14 patients with cholesteatoma, 7 patients are underwent CWD and 7 patients are underwent CWU. In two patients defect was observed in the facial canal intraoperatively. In eight patients, bone chain was complete and mobile, while in six patients the bone chain was not intact. Three patients had incus reposition, one patient had PORP and two patients had TORP inserted. Postoperatively, two patients had perforated graft material. Of 15 patients with granulation tissue, one patient are underwent CWD and 14 patients are underwent CWU. In any patients defect was not observed in the facial canal intraoperatively. In 14 patients, bone chain was complete and mobile, while in one patient the bone chain was not intact. One patients had incus reposition postoperatively; four patients had perforated graft material.

Regardless of surgical technique, the PTA 0.5, 1, 2, 4 and 8 kHz ABG results for patients are shown in Table 2. At 0.5 kHz, the preop ABG mean ± SD was 31.2 ± 12.00, postop was 24.6 ± 10.8 with difference of mean 6.5 ± 9.4. At 1 kHz, preop ABG mean was 32.1 ± 14.2, postop was 24.6 ± 10.8 and the difference was 10.6 ± 15.5. At 2 kHz the preop ABG was 20.9 ± 10.0, postop was 9.3 ± 2.4 and the difference was 11.5 ± 12.3. At 4 kHz, the preop ABG was 17.5 ± 9.3, postop was 12.5 ± 8.5 and the difference was mean 5± 11.5. At 8 kHz the preop ABG mean was 21.8 ±16.4, postop was 21.8 ± 16.4 and the difference was mean 9.3 ± 8.5. When the preoperative and postoperative ABG for the patients are compared, there were statistically significant differences identified at 0.5, 1, 2 and 8 kHz (p=0.014, p=0.016, p=0.002, p=0.001, respectively). However, there was no statistically significant difference identified at 4 kHz (p=0.104) (Figure 1).

ABG results for patients who underwent CWU are compared .When at 0.5 kHz, the preop ABG was 31 ± 9.2, postop was 20 ± 10.4. At 1 kHz, preop ABG was 33.5 ±11.7, postop was 16.2 ± 7.4 At 2 kHz the preop ABG was 22.2 ± 8.2, postop was 8.2 ± 9.5 and. At 4 kHz, the preop ABG was 19.5 ± 8.8, postop was 13.2 ± 8.7. At 8 kHz the preop ABG mean was 21.2 ±14.6, postop was 12.8 ± 12.1. When the preoperative and postoperative ABG for the patients who underwent CWU are compared, there were statistically significant differences identified at 0.5, 1, 2 ,4 and 8 kHz (p<0.001, p<0.001,p=0.001, p=0.043, p=0.002, respectively).

Table 2. Comparison of preoperative and postoperative ABG values (mean±standard deviation)

	0.5 kHz	1 kHz	2 kHz	4 kHz	8 kHz
Pre-op.	31.2 ± 12.0	32.1 ± 14.2	20.9 ± 10.0	17.5 ± 9.3	21.8 ±16.4
Post-op.	24.6 ± 10.8	21.5 ± 9.2	9.3 ± 2.4	12.5 ± 8.5	12.5 ± 12.9
Difference	6.5 ± 9.4	10.6 ± 15.5	11.5 ± 12.3	5 ± 11.5	9.3 ± 8.5
P value	0.014*	0.016*	0.002*	0.104	0.001*

ABG results for patients who underwent CWD are compared . When At 0.5 kHz, the preop ABG mean ± SD was 30.8 ± 12, postop was 21.6 ± 4.1. At 1 kHz, preop ABG mean was 29.1 ± 11.1, postop was 17.5 ± 4.2 At 2 kHz the preop ABG was 21.7 ± 18.3, postop was 15.8±8.4 and. At 4 kHz, the preop ABG was 17.5 ± 13.3, postop was 16.7 ±5.2. At 8 kHz the preop ABG mean was 15.8 ±13.5, postop was 13.3 ± 10.3. When the preoperative and postoperative ABG for the patients who underwent CWD are compared, there were statistically significant differences identified at 0.5, 1,

(p=0.02, p=0.02, respectively).There were not statistically significant differences identified at 2 ,4 and 8 kHz (p=0.09, p=0.31, p=0.83, respectively).

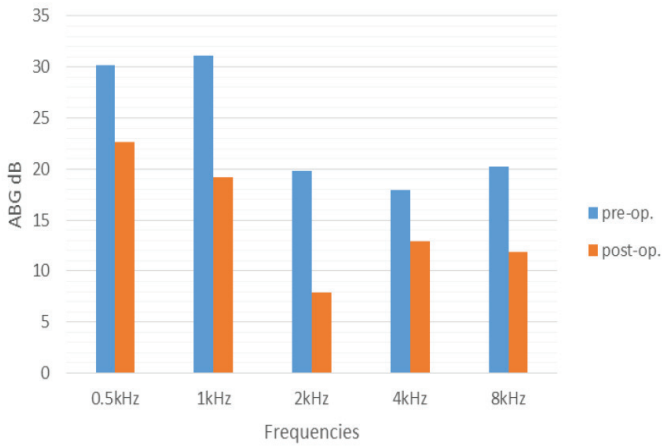

Figure 1. Preoperative and postoperative hearing outcomes

DISCUSSION

In this study, statistically significant levels of hearing gain were provided at 0.5, 1, 2 and 8 kHz; however, there was no hearing gain at 4 kHz after the surgical procedure. Regardless of surgical technique, the disease control rate for patients with chronic otitis media was 79.3%. The disease control rate was 74% for patients with cholesteatoma and 85.8% for patients with granulation tissue. In this study, the recurrence rate was 6 (20.6%) after 12.6 ± 1.3 months follow-up duration. Graft perforation and presence of discharge were accepted as recurrence. Residual disease was not identified.

Without regard to surgical technique, the disease control rate for cholesteatoma-free chronic otitis is reported as 63-96% (7-9). However, disease control is 75-90% for cholesteatoma cases (10-12). The recurrence or residual disease rate in patients undergoing CWU is higher (13, 14). However, it is reported that in cases with widespread cholesteatoma recurrence rates are equal with the CWU and CWD techniques (15). A meta-analysis study by Tomlin et al. identified the residual disease rate as 5-17% after CWD, while this rate was 9-70% after CWU (4). While the tendency for residual disease is higher for CWU surgery, the tendency for recurrent disease is reported to be higher with CWD (5). Azevedo et al. recommend the CWD technique for widespread cholesteatoma surgery and they found that CWD technique is superior to CWU but there were no differences in post-operative hearing thresholds between the two techniques (16).

CONCLUSION

In this study, the follow-up duration for patients was 12.6 ± 1.3 months. This is not enough for evaluating long follow-up is important for cholesteatoma recurrence these patients. At least 5-year follow-up is recommended for patients undergoing CWD and CWU (17). But this time, it was long enough for evaluating the hearing levels in these patients. A study by Kim et al. found ABG gain of less than 20 dB in 68.4% with the CWU technique and 58.6% with the CWD technique. Additionally, they found no difference in terms of hearing gain between the CWU and CWD techniques in patients (16). Similarly, another study identified mean preoperative ABG as 33.9 ± 2.6 dB and mean postoperative ABG as 32.5 ± 2.9 dB. They did not identify a significant difference before and after surgery (18). However, the difference between the two techniques in terms of middle ear volume should not be ignored. Temporal bone studies have identified hearing gain below 1 kHz with the CWU technique and above 1 kHz for the CWD technique (19). Regardless to surgical technique, hearing gain was present at all frequencies apart from 4 kHz in this study and additionally disease control rates were close to the rates in the literature. Further studies with larger group of patients and long term of follow-up are needed for hearing gain, healing and hearing mechanisms.

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