

## Hearing result from the mastoid surgery of non-complicated chronic middle ear infection : A comparative study between canal wall up mastoidectomy and canal wall down mastoidectomy with tympanoplasty

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**Objective** : *To compare the hearing result from two types of mastoid surgery in the noncomplicated chronic middle ear infection: the canal wall up mastoidectomy and canal wall down mastoidectomy with tympanoplasty.*

**Design** : *Prospective, randomized trial*

**Setting** : *Department of Otolaryngology, Faculty of Medicine, Chulalongkorn University*

**Patients and Methods** : *Twenty eight patients with chronic suppurative otitis media (29 ears) underwent either the canal wall up mastoidectomy (CWU) or canal wall down mastoidectomy with tympanoplasty (modified radical mastoidectomy, MRM) during a 2 - year period (January 1995 to December 1996).*

- Result** : *Eighteen ears were acquired cholesteatoma, 11 ears were severe fibrosis and/or granulation tissue formation. The means of air conduction threshold, air conduction gain and air bone gap closure of the CWU were 46.8 dB, 3.3 dB and 2.1 dB respectively while the results of the MRM " were 53.2 dB, 8.0 dB and 6.5 dB. However; the differences of the results from both groups were not statistically significant ( $p > 0.05$ ).*
- Conclusion** : *Hearing results from both groups were different, but were not statistically significant. The authors prefer MRM as the procedure of choice for treatment of chronic suppurative otitis media without complications.*
- Key words** : *Chronic otitis media, Cholesteatoma, Mastoidectomy, Tympanoplasty.*

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นาคยา มาคเซนทร์, ภาคภูมิ สุปียพันธ์ุ, เสาวรส อัสวีเชียรจินดา. ผลการได้ยินจากการผ่าตัดโพรงกระดูกมาสตอยด์ในโรคหูชั้นกลางอักเสบเรื้อรังชนิดไม่มีโรคแทรกซ้อน: การศึกษาเปรียบเทียบระหว่างการผ่าตัดโพรงกระดูกมาสตอยด์ชนิด canal wall up และ canal wall down ร่วมกับการปะแก้วหูและซ่อมแซมระบบการได้ยิน. จุฬาลงกรณ์เวชสาร 2540 ส.ค;41(8): 565-74

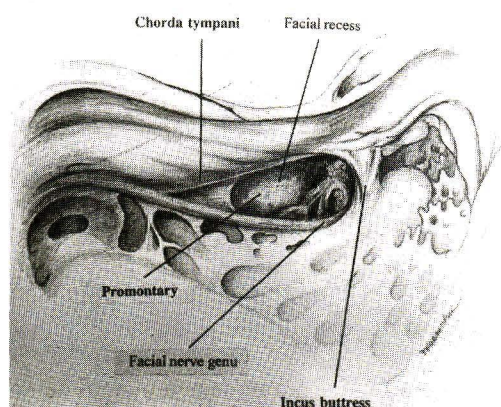
- วัตถุประสงค์** : เพื่อเปรียบเทียบผลของการได้ยินจากการผ่าตัดโพรงกระดูกมาสตอยด์ 2 ชนิด ในการศึกษาโรคหูน้ำหนวกเรื้อรัง คือการผ่าตัดโพรงกระดูกมาสตอยด์ชนิด canal wall up และชนิด canal wall down ร่วมกับการปะแก้วหู และซ่อมแซมระบบการได้ยิน
- ชนิดของการวิจัย** : ศึกษาไปข้างหน้าแบบแรนดอมไมส์
- ประเภทของโรงพยาบาล** : ภาควิชาโสต นาสิก ลาริงซ์วิทยา คณะแพทยศาสตร์จุฬาลงกรณ์มหาวิทยาลัย
- ผู้ป่วยและวิธีการ** : ผู้ป่วยโรคหูน้ำหนวกเรื้อรังจำนวน 28 คน (29 หู) ได้รับการผ่าตัดเพื่อรักษาโรคโดยวิธีการผ่าตัดโพรงกระดูกมาสตอยด์ชนิด canal wall up (CWU) หรือ canal wall down ร่วมกับการปะแก้วหู (หรือเรียกว่าการผ่าตัด modified radical mastoidectomy-MRM) ในช่วง 2 ปี (ระหว่างเดือนมกราคม 2538 ถึงเดือนธันวาคม 2539)
- ผลการศึกษา** : หูชั้นกลางอักเสบจำนวน 18 หู เกิดจากโรค cholesteatoma และอีก 11 หูจากพังผืด และ granulation tissue ผลการได้ยินพบว่า ค่ามัชฌิมของ air conduction threshold, air conduction gain และ air bone gap closure ในกลุ่ม CWL มีค่าเท่ากับ 46.8 เดซิเบล, 3.8 เดซิเบล และ 2.1 เดซิเบล ตามลำดับ และในกลุ่ม MRM มีค่าเท่ากับ 53.2 เดซิเบล, 8.0 เดซิเบล และ 6.5 เดซิเบล ตามลำดับอย่างไรก็ตามค่าความแตกต่างนี้ไม่มีนัยสำคัญทางสถิติ
- สรุป** : ผลของการได้ยินหลังจากการผ่าตัดใน 2 กลุ่ม (CWU และ MRM) มีความแตกต่างกัน แต่ไม่มีนัยสำคัญทางสถิติผู้วิจัยเห็นว่าการผ่าตัดชนิด MRM เหมาะสมกว่าในการรักษาโรคหูน้ำหนวกเรื้อรังชนิดที่ไม่มีโรคแทรกซ้อน

The primary goals of surgical treatment of severe chronic middle ear infection are to prevent complications, to eradicate the disease and to control its recurrence. Improvement or maintenance of hearing function is a secondary goal. The canal wall-up mastoidectomy (CWU) procedure is better for hearing function because it disturbs the normal external and middle ear anatomy less than other techniques.<sup>(1)</sup> But with this treatment, the recurrence and residuals of the disease are as much as 30-70 % in various reports.<sup>(2-4)</sup> On the contrary, the canal wall-down mastoidectomy (CWD) with tympanoplasty usually gives more promising control of the disease and the hearing outcome is frequently satisfactory.<sup>(5-6)</sup> The purpose of this study was to compare the hearing results between CWU and CWD mastoidectomy with tympanoplasty in cases of severe but non-complicated chronic middle ear infection.

### Patients and methods

From January 1, 1995 to December 31, 1996, 31 patients (32 ears) with cholesteatoma, granulation tissue or/and fibrosis, in addition to the chronic middle ear infection, were enrolled in the study.

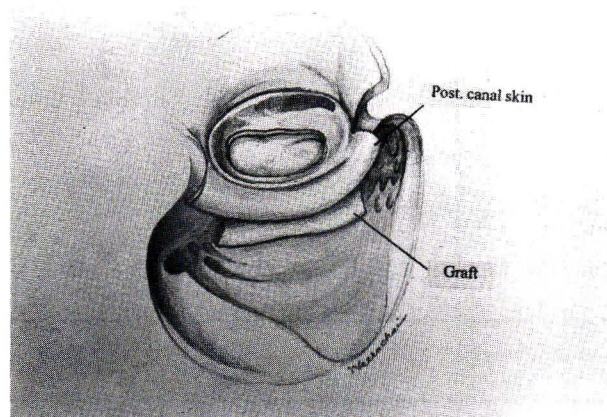
They underwent either a CWU or CWD mastoidectomy with tympanoplasty (modified radical mastoidectomy-MRM) procedure to control the disease and to reconstruct the hearing mechanism. Each patient was admitted into the in-patient ward of the Otolaryngology Department of Chulalongkorn University Hospital a day before the operation. The ears were reevaluated for their disease condition, and the audiograms and all laboratory results were rechecked. One patient had a severe infection from an extensive cholesteatoma and complicated with a post-auricular abscess. Two patients had no preoperative audiograms. These three patients were excluded, leaving 28 patients (29 ears) in the study. The operative techniques for CMU and CWD mastoidectomy with tympanoplasty have been described elsewhere.<sup>(7-8)</sup> In the CWU group, there were 15 patients between 13 to 52 years age (mean 34.8 years). The male to female ratio was 5 to 10. (Table 1) Each patient in this group underwent a complete simple mastoidectomy with posterior tympanotomy (facial recess approach) for a complete removal of the diseased tissue in the middle ear and mastoid. (Figure 1)



**Figure 1.** Canal wall up mastoidectomy with tympanoplasty: the middle ear is approached via posterior tympanotomy (facial recess).

In case of incus erosion or incus involvement from the disease, it had to first be removed for better exposure, and later interposed. If the mucosa of the middle ear was severely damaged, a staged tympanoplasty with ossicular reconstruction was scheduled within the following 6 to 12 months. In CWD with tympanoplasty or MRM, there were 14 patients between 16 to 72 years of age (mean 33.3 years). There were 5 males and 9 females. (Table 1) A complete mastoidectomy with lowering of the posterior canal was done to exteriorize the mastoid cavity into the newly

enlarged external ear meatus. (Figure 2.) The cholesteatoma and all diseased tissue were completely removed. For the diseased tissue wrapping around the ossicles and/or extending into the facial recess, sulcus tympani and anterior epitympanic recess, incus removal and malleus head resection were needed for clear vision. Finally, a tympanoplasty and ossicular reconstruction either with or without incus interposition were performed. These patients should have regular follow-ups for at least 10 weeks.



**Figure 2.** Modified radical mastoidectomy: the tympanic membrane is repaired by the temporal fascia graft lying upon the mastoid

**Table 1.** Details of patients.

	CWU	MRM
Number of ears	15	14
Male/Female	5/10	5/9
Mean of age (yr)	34.8	33.3
Cholesteatoma	6	12
Severs fibrosis	2	1
Granulation tissue	7	1

Pre- and postoperative audiograms were performed and recorded in each patient. The average of air conduction pure tone thresholds at 0.5, 1 and 2 KHz, air conduction gain and air bone gap closure from both techniques were statistically analyzed (paired t-test).

## Results

In this series, the severe, but non-complicated cases of chronic middle ear infection were cholesteatoma, severe fibrosis or extensive granulation tissues in the middle ear. There were 18 cholesteatomas (62 %), three fibrosis (10.5 %) and eight granulation tissues (27.5 %) cases. In 15 ears of the CWU group, there were six cholesteatomas (40 %) and nine non-cholesteatomas

(60 %). In comparing the 14 MRM cases, the number of cholesteatoma cases rose up to 12 ears (85.7 %), and non-cholesteatomas comprised only 2 ears (14.3 %) (Table 1). Concerning the disease factors which influenced the hearing results in both groups (Table 2.), the mean duration of the disease were almost the same (11.7 years for CWU and 12.1 years for MRM). There were slightly higher rates of ossicular chain problems in the MRM group (9 ears = 64.3 %) than in the CWU group (6 ears = 40 %). Erosion of the long process of incus was the most common ossicular problem in nine ears (31 %). The other were loss of stapes suprastructure in five ears (17.2 %) and eroded malleus handle in one ear (3.4 %).

**Table 2.** Factors influencing the hearing results.

Factors	CWU	MRM
Mean of disease duration (yr)	11.7	12.1
Ossicular chain discontinuity resulting either from disease or surgery requiring reconstruction	6	9
Extensive disease (wrapping around the ossicles, extending into oval/round window area, and/or into anterior epitympanum)	3	4
Severe mucosal damage requiring a stent and staged surgery	1	3
Eustachian tube dysfunction	3	3
Traumatic surgery	4	4



Removal of extensive cholesteatoma, fibrosis and/or granulation tissue from the ossicles, anterior epitympanum, oval window and round window was required for three ears (20 %) and four ears (28.5 %) in the CMU and MRM group respectively. However, it was quite a difficult task to manage.

Severe mucosal damage usually accompanied the extensive disease and required a stent and staged surgery. It was more prevalent in the MRM group (21 %) as compared to 6.7 % in the CWU group. Furthermore, eustachian tube dysfunction and traumatic surgery were the other two common factors that influenced the hearing results. It was almost equally found in both groups. (Table 2)

We measured the air conduction thresholds, bone conduction thresholds and air bone gaps in both pre- and postoperative periods. We calculated the hearing outcomes in terms of mean postoperative air conduction thresholds (x AC[po]) air conduction gain (d AC), bone conduction gain (d BC) and air bone gap closure (d ABC). We used these parameters to compare the hearing results between the two groups. The x AC(po), d AC, d BC and d ABC of the CWU group were 46.8 dB, 3.3 dB, 0.6 dB and 2.1 dB, respectively. The data for MRM were 53.2 dB, 8.0 dB, 1.5 dB and 6.5 dB. The difference in each pair of data was not statistically significant, and each group showed a high tone drop resulting from surgical trauma.

## Discussion

Although the prevention of complications, eradication of the infection and control of recurrence are the primary concerns in treating chronic middle ear infection, hearing function is usually taken into consideration even in the most severe case. The CWU and MRM procedures were developed for preservation of hearing function. Both techniques provide a feasibility for ossicular chain reconstruction. The CWU procedure is reported to cause less disturbance to normal external and middle ear anatomy, and hence to hearing, than MRM, but disease recurrence rates may be high.<sup>(2-5)</sup> In our study, the ratio of male to female patients, average of ages, and mean of duration of disease were nearly equal in both groups. The number of cholesteatoma cases undergoing MRM was 12 and that for CWU was 6. This 2:1 ratio for cholesteatoma cases in each technique may be due to the doctor's preference of MRM treatment over CWU. Some cholesteatoma cases were initially selected for CWU procedure, but the final decision was changed during the operation due to clinical features. The reasons varied between extensive destruction from the disease itself and the surgeon and the patient's incompatibility for follow-up. To maintain CWU cases free of disease usually required more operations and a longer periods of close follow-up than for CWU cases.<sup>(9)</sup> Most of our patients did not accept the staged CWU technique, which required reoperation for

determining recurrence. MRM treatment was safer in those patients as a long follow-up was not feasible because the recurrence of cholesteatoma indicated a need for continued observation of all patients treated by closed procedures.<sup>(10)</sup>

The factors influencing the post-operation hearing results as determined from many studies include the duration of disease, extensiveness of disease, presence of the ossicular chain, traumatic surgery and post-operative status.<sup>(7,8,11,12)</sup> Black, in 1992, attempted to address the degree of difficulty for individual ears as the so-called SPITE score. Hearing results are adversely affected by 1) the need for extensive surgery -S, 2) ossicular chain discontinuity requiring insertion of prosthesis-P, 3) infection-I, 4) the poor condition of middle ear tissue-T, and 5) eustachian tube dysfunction as

represented by middle ear effusion or posterosuperior cholesteatoma-E. If one allots a score (O-absent, 1-present) to each of these factors, a high score will be reflected by a poor hearing outcome and vice versa.<sup>(13)</sup> In our study the disease in the CWU group might be less severe than in the MRM group since percents of ossicular discontinuity, the extensiveness of disease, severe mucosal loss and postoperative middle ear fibrosis were higher in the MRM cases. The hearing outcome among the CWU cases should be better among the MRM, but, in fact, the results from both groups were not statistically significantly different. (Table 3) This finding is well correlated to other series.<sup>(6,8,9,14)</sup>

Long term hearing results could not be obtained in this 2-year study, the follow-ups were not long enough to demonstrate the final outcome.

**Table 3.** Audiogram evaluation.

	CWU		MRM	
	Preoperative	Postoperative	Preoperative	Postoperative
Air conduction (dB)*				
Mean (xAC)	50.0	46.8	61.1	53.2
Air conduction gain (dAC)	3.3		8.0	p>0.05
Bone conduction (dB)*				
Mean (xBC)	24.1	23.5	31.7	30.2
Bone conduction gain (dBC)	0.6		1.5	p>0.05
Air bone gap (dB)*				
Mean (xABG)	25.9	23.8	29.5	23.0
Air bone gap closure (dABG)	2.1		6.5	p>0.05

\*dB = decible



A 2-month post-operative audiogram was performed instead. The means of air conduction thresholds (x AC), air conduction gain (d AC), bone conduction thresholds (x BC), air bone gap (x ABG) and air bone gap closure (d ABG) in both groups were nearly equal, and showed no statistically significant difference. However, air conduction thresholds might become elevated in the long-term because some ears would have undergone a progressive fibrotic change which is often found in cases of severe mucosal loss and/or eustachian tube dysfunction.<sup>(7)</sup> Smyth's criteria for patient satisfaction in operations to improve hearing stated that a reduction of the intraural difference of less than 15 dB, or an AC average of less than 30 dB should be accepted.<sup>(15)</sup> We found only 13.4 % of the CWU cases and 7.2 % of the MRM cases fitting those criteria, and those patients have servicable hearing. The poor results in our study will lead to a re-evaluation of the techniques and materials used in the procedure. Nevertheless, our study demonstrated that the outcomes from the CWU and MRM procedures were nearly equal, but we highly recommend MRM as the procedure of choice for severe chronic middle ear infection especially for the patients from rural areas.

### Conclusions

1. Hearing results of the CWU mastoidectomy and MRM for severe but non-complicated chronic middle ear infections are nearly the same.

2. The difference of means of air conduction threshold (postoperative), air conduction gain, and air bone gap closure between the CWU and MRM groups were not statistically significant.

3. We recommended MRM as the procedure of choice for severe non-complicated chronic middle ear infections because of its greater simplicity and lack of requirement for long-term follow-up for a disease free interval when compared to CWU procedure.

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