

## Evaluation of hearing limits post tympanoplasty in patients with chronic suppurative otitis media



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### ABSTRACT

**Background:** Chronic suppurative otitis media (CSOM) causes partial or complete damage to the tympanic membrane and ossicles, causing hearing loss in the form of conductive and mixed hearing loss with a decrease of up to 60 dB. This study aimed to evaluate the hearing threshold before and after tympanoplasty surgery in CSOM patients.

**Methods:** This type of research was carried out in a retrospective descriptive manner. The materials in this study were the medical records of CSOM patients who underwent canal wall up (CWU) tympanoplasty and canal wall down (CWD) tympanoplasty at the outpatients of ear, nose, and throat – head and neck surgery (ENT-HNS) Otology Division Dr. Soetomo Hospital Surabaya for the period January 1, 2018 to December 31, 2018 with a total of 51 patients. This study analyzed with the Wilcoxon test.

**Results:** The mean age was 30.96 years (51% female and 49% male). Postoperatively 40 (78.5%) patients experienced an increase in hearing threshold, 10 (19.6%) patients experienced a decrease and 1 (1.9%) patient remained. The average increase in air-bone gap (ABG) pre and post tympanoplasty surgery was 9.78 dB, from 38.92 dB to 29.14 dB.

**Conclusion:** There was an increase in hearing threshold after tympanoplasty.

**Keywords:** CSOM, tympanoplasty, hearing threshold, life expectancy.

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## INTRODUCTION

Chronic suppurative otitis media (CSOM) can cause morbidity and mortality so that until now it is still a major health problem worldwide. Chronic suppurative otitis media (CSOM) is a chronic inflammatory disease of the middle ear which is characterized by perforation of the tympanic membrane and secretions that comes out continuously or comes and goes for more than three months. Otorrhoea is usually painless and odorless. The prevalence in the world is 65-300 million people with otorrhoea, 60% suffer from significant hearing loss. The incidence of CSOM in Indonesia (1994-1996) is estimated at around 8.36 million patients and the prevalence of CSOM in general is around 3.8%.<sup>1</sup> Patient medical record data at outpatients clinic of ear, nose, and throat – head and neck surgery (ENT-HNS) Otology Division Dr. Soetomo Hospital Surabaya for the period January 1 2018 to December 31 2018 the number of CSOM patients was 115 patients, 60 patients underwent canal wall up (CWU) tympanoplasty and 55 patients with canal

wall down (CWD) tympanoplasty.<sup>1,2</sup>

Chronic suppurative otitis media causes partial or complete damage to the tympanic membrane and ossicles resulting in conductive and mixed hearing loss with a decrease of up to 60dB. The long-term success of tympanoplasty is highly dependent on the ear surgeon, level of patient compliance, Eustachian tube function, middle ear conditions and mucosal conditions.<sup>3</sup> Identification of CSOM to avoid delayed treatment and reduce morbidity. The most common intracranial complications of CSOM are brain abscess, it was followed by meningitis, lateral sinus thrombophlebitis, extradural abscess and subdural abscess. The most common extracranial complications of CSOM are subperiosteal abscesses, it was followed by labyrinthitis, mastoid abscesses, facial paralysis and Bezold's abscesses.<sup>4</sup>

Patients of CSOM with the presence or absence of cholesteatoma both require surgical management. Surgery of CSOM with the aim of eradicating pathological tissue and infection in the middle ear as well as reconstructing the hearing

mechanism with or without a graft and reconstruction of the auditory bones, this surgical technique can be combined with canal wall down (CWD) or canal wall up (CWU) tympanoplasty.<sup>2</sup> Pure tone audiometry is a routine examination prior to ear surgery to assess hearing function and quantitatively assess the pure-tone average (PTA) of CSOM patients.<sup>5</sup> Post operative hearing outcome parameters were mean changes in hearing threshold, hearing level and air-bone gap (ABG) with an increase in the hearing threshold that exceeds 10 dB. Audiometry is measured at a frequency of 500, 1000, 2000 Hz because these frequencies represent everyday conversations.<sup>6</sup> This study aimed to evaluate the hearing threshold before and after surgery and to improve the management of CSOM to be better so as to improve the quality of hearing.

## METHODS

This type of research was carried out in a retrospective descriptive manner. The materials used in this study were the medical records of CSOM patients

who underwent CWU tympanoplasty and CWD tympanoplasty at outpatient clinic of ENT-HNS Otolaryngology Division at Dr. Soetomo Hospital Surabaya for the period January 1, 2018 to December 31, 2018. The population in this study were all CSOM patients who underwent CWU tympanoplasty and CWD tympanoplasty.

The research sample was CSOM patients who met the inclusion and exclusion criteria. The inclusion criteria were basic data of CSOM patients, diagnosis, operation reports, audiometric results before and after surgery. The exclusion criteria were incomplete medical records. All data collected in medical records are arranged into tables based on age, sex, type of CSOM and pre and postoperative audiograms. This research has obtained an Ethical Clearance Statement from the Health Research Ethics Committee of Dr. Soetomo Hospital Surabaya with number 0474/LOE/301.4.2/V/2021.

Data were collected and documented. The difference of air conduction (AC), bone conduction (BC), and air bone gap (ABG) between pre and post-surgery analyzed with Wilcoxon test. All results were expected to be significant at a p-value < 0.05. Statistical analysis was done using Statistical Package for Social Science (SPSS) software (Version 25, IBM).

## RESULT

In the period of January 1, 2018 to December 31, 2018, 115 tympanoplasty operations were carried out, consisting of 60 patients (52.1%) CWU tympanoplasty, the rest underwent CWD tympanoplasty in 55 patients (47.8%). Of the 115 patients who underwent surgery, only 51 patients (44.3%) had complete postoperative evaluation data and 64 patients (55.7%) were not controlled so the data was incomplete with various possibilities that the patient felt better, could not come because the time for treatment at work and home hours is too far away.

Characteristics based on the age group 0-30 years a total of 29 patients and ages 31-70 years a number of 22 patients. Based on gender, there were 25 male patients and 26 female patients. Based on the type of CSOM with a safe type of 34 patients and a dangerous type of 17 patients. Pre and post-operative audiograms can be seen in the following tables.

The most common types of hearing loss pre operative were mixed in 33 patients (64.8%) and conductive in 18 patients (35.2%). The results also showed that the highest level of hearing loss pre operative was moderate-severe in 17 patients (33.3%) and at least 1 patient (1.9%) had a

normal level (Table 1).

There was an increase in the average pre and post-operative AC hearing threshold of 14.48 dB (Table 2). The results of this study also showed an increase in the average pre and post operative BC hearing threshold of 4.43 dB (Table 3). Bone conduction (BC) value indicates cochlear function while AC assesses overall auditory function. Hearing threshold in BC is not an exact measure of cochlear function because it can be affected by pathological conditions in the middle ear. Regarding the ABG, there was average increase in pre and post-operative ABG of 9.78 dB (Table 4). Post operative hearing threshold increase in 40 patients (78.5%), 10 patients (19.6%) decreased and 1 patient (1.9%) remained (Table 5).

## DISCUSSION

Most CSOM events occurred at the age of <30 years (56.9%) and aged 31-70 years (43.1%). At present the age of children entering primary school is 6 years and those who will continue to secondary school, hearing is very important to develop knowledge.<sup>7</sup> This is in accordance with the literature which states that the incidence of CSOM is more common at the age of <30 years (66.6%) than age > 30

**Table 1.** Types and levels of hearing loss pre and post-surgery.

Level of Hearing Loss	Types of Hearing Loss							
	Conductive		Mixed		Sensorineural		Total, n (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Normal	1	11	0	1	0	2	1 (1.9)	14(27.4)
Mild	7	11	4	1	0	2	11 (21.6)	14(27.4)
Moderate	5	4	4	4	0	0	9 (17.6)	8 (15.7)
Moderate-ly severe	5	2	12	5	0	0	17 (33.3)	7 (13.8)
Severe	0	0	7	3	0	0	7 (13.8)	3 (5.9)
Profound	0	0	6	5	0	0	6 (11.8)	5 (9.8)
<b>Total, n</b>	<b>18</b>	<b>28</b>	<b>33</b>	<b>19</b>	<b>0</b>	<b>4</b>	<b>51</b>	<b>51</b>
<b>(%)</b>	<b>(35.2)</b>	<b>(54.9)</b>	<b>(64.8)</b>	<b>(37.3)</b>	<b>(0)</b>	<b>(7.8)</b>	<b>(100)</b>	<b>(100)</b>

**Table 2.** Differences in air conduction (AC) pre and post-operation.

Frequency	n	Pre				Post		p-value
		Mean (dB)	Intensity (dB)		Mean (dB)	Intensity (dB)		
			Min	Max		Min	Max	
500 Hz	51	63.13	15	120	48.52	15	120	0.000
1000 Hz		60.78	20	120	45.39	5	120	0.000
2000 Hz		57.64	20	120	44.21	5	120	0.000
4000 Hz		62.84	15	120	49.70	5	120	0.000
AC		60.52	15	120	46.04	5	120	0.000

AC: Air conduction

**Table 3.** Differences in bone conduction (BC) pre and post-surgery.

Frequency	N	Pre			Post			p-value
		Mean (dB)	Intensity (dB)		Mean (dB)	Intensity (dB)		
			Min	Max		Min	Max	
500 Hz	51	18.13	0	65	12.74	0	65	0.004
1000 Hz		16.96	0	70	12.15	0	75	0.004
2000 Hz		25.68	0	75	24.01	0	80	0.110
4000 Hz		28.52	0	80	22.64	0	75	0.003
BC		22.32	0	80	17.89	0	80	0.000

BC: Bone conduction

**Table 4.** Differences in air bone gap (ABG) pre and post-surgery.

Frequency	n	Pre			Post			p-value
		Mean (dB)	Intensity (dB)		Mean (dB)	Intensity (dB)		
			Min	Max		Min	Max	
500 Hz	51	45.19	10	110	35.78	0	90	0.009
1000 Hz		44.01	0	110	33.52	0	85	0.000
2000 Hz		31.96	0	85	20.19	0	70	0.000
4000 Hz		34.50	0	80	22.64	0	75	0.017
ABG		38.92	0	110	29.14	0	90	0.000

ABG: Air bone gap

**Table 5.** Distribution of post-operative hearing threshold increases.

Listening Threshold Change (dB)	n	%
0-5	17	33.3
>5-10	5	9.8
>10-15	8	15.7
>15	21	41.2
<b>Total</b>	51	100.0

years (33.4%).<sup>8</sup>

The incidence of CSOM was not much different between men (49%) and women (51%). The ratio of men to women is 1:1.08 which shows that women are also looking for education and work. This is in accordance with the literature which states that there are slightly more female CSOM patients (54%) than men (46%).<sup>7</sup>

The incidence of CSOM was safe type (66.7%) and dangerous type (33.3%). Chronic suppurative otitis media is distinguished by the type of safe and dangerous by the presence or absence of cholesteatoma and the complications encountered. The incidence of CSOM almost always begins with recurrent otitis media in children and rarely begins as an adult. Prompt and adequate treatment and with repair of the ventilation function of the middle ear, usually the pathological process will stop and the mucosal abnormalities will return to normal.

Permanent changes in the middle ear mucosa that are progressive can cause complications such as those that occur in the dangerous type of CSOM.<sup>2</sup>

The level of hearing loss is proportional to the size of the perforation and the longer duration of CSOM. The level of hearing loss is caused by several factors such as necrosis of the ossicles in the middle ear and sclerosis of the mastoid air cells which causes a decrease in the volume of the mastoid air cells. This suggests that, if a patient with CSOM had surgery earlier, it would not only improve hearing but also prevent the worsening of hearing loss that might occur over time. Effusion in the middle ear prevents the ossicles from conducting sound vibrations from the eardrum to the oval window, causing conductive hearing loss. In addition, inflammatory mediators produced during CSOM can penetrate into the inner ear through the round window. This can cause

loss of hair cells in the cochlea and will cause sensorineural hearing loss, so that mixed hearing loss can occur.<sup>2</sup>

The highest level of post operative hearing loss was normal and mild with 14 patients (27.4%) each and the least was severe in 3 patients (5.9%). This is in accordance with the literature which states that an increase in the hearing threshold is also an expected benefit in addition to the main goal.<sup>3</sup> The results of the study also showed the type of post operative sensorineural hearing loss in 4 patients (7.8%). This is in accordance with the literature which states that the incidence of post operative permanent sensorineural hearing loss is 1.2-4.5%. Sensorineural hearing loss is one of the most important complications of surgery. The most common causes are removal of the cholesteatoma from the semicircular canals and removal of the fistula membrane. The most common factors are cochlear damage caused by excessive reconstructive motion of the ossicles and acoustic trauma caused by drills and suction devices.<sup>9</sup>

Increase in the level of normal hearing loss from pre operative 1 patient (1.9%) to 14 patients (27.4%) post operative, mild preoperative level of hearing loss from 11 patients (21.6%) to 14 patients (27.4%) post

operative operation. This is in accordance with the literature which states changes in the level of pre and post operative hearing loss in 86 patients, normal hearing loss from 12 patients to 59 patients, mild hearing loss from 65 patients to 27 patients and moderate hearing loss from 9 patients to 0 patients.<sup>10</sup>

This is in accordance with the literature which states that there is a difference in the average pre and post operative AC in 30 patients of 9.4 dB, from 43.9 dB to 34.5 dB.<sup>11</sup> Other literature states that there is a difference in the average pre and post operative BC surgery on 72 patients of 1.9 dB, which was previously 12.4 dB to 10.5 dB.<sup>12</sup>

The most common manifestations of perforation of the tympanic membrane are conductive hearing loss and discharge from the ear. Closure of this perforation prevents the middle ear mucosa from exogenous pathogens, restores the function of the tympanic membrane, provides protection of the round window and thereby improves hearing.<sup>2</sup>

This is in accordance with the literature which states that the average pre and post operative ABG increase in 66 patients was 8.8 dB, from 38.10 dB previously to 29.30 dB.<sup>13</sup> The auditory bones in CSOM with or without cholesteatoma can experience necrosis and erosion.<sup>8</sup> High-resolution computed tomography (HRCT) scan of the temporal bone is performed to obtain a good image reconstruction and provide meaningful information, whether there are structural abnormalities in the temporal bone or the structure of the soft tissue in it.<sup>14,15</sup> Operators who know the presence of necrosis and erosion of the ossicles can better prepare surgical techniques and reconstruct the ossicles if necessary.<sup>8</sup>

This is in accordance with the literature which states an increase in the minimum hearing threshold of 9.5 dB and a maximum of 28 dB.<sup>16</sup> Other literature states an increase in the post-operative hearing threshold of 60 patients, 47 patients experienced an increase, 1 patient experienced a decrease and 12 patients remained.<sup>17</sup> The same result also obtained from other study, in which there was an increase in the mean hearing threshold between pre and post-surgery.<sup>18</sup> Surgery on CSOM is an art and the best results are determined by experienced operators.<sup>8</sup>

## CONCLUSION

Postoperative hearing threshold increase in most of the patients. The average increase in the pre and post-surgery AC hearing threshold was 14.48 dB. The average increase in the pre and post-operative BC hearing threshold was 4.43 dB, while the average increase in ABG pre and post-tympanoplasty operations was 9.78 dB. Communication of information and education to patients that it is possible to control regularly after surgery so that they can find out the progress of hearing from the operation.

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## CONFLICT OF INTEREST

The author reports no conflicts of interest in this research.

## ETHICAL CONSIDERATION

This research has obtained an Ethical Clearance Statement from the Health Research Ethics Committee of Dr. Soetomo Hospital Surabaya with number 0474/LOE/301.4.2/V/2021.

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## AUTHOR CONTRIBUTION

NP responsible for concept and design of the study, literature search, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review. THA supporting the concept of the study, data analysis, and manuscript editing.

## REFERENCES

1. Artono A, Purnami N, Rahmawati R. Biofilm Bacteria plays a role in CSOM pathogenesis and has significant correlation with unsafe type CSOM. *Folia Medica Indones*. 2016;51(4):208.
2. Mansour S, Magnan J, Nicolas K, Haidar H. Chronic suppurative otitis media (CSOM): a middle ear mucosal disease. In *Middle Ear Diseases*. Springer, Cham 2018; 6:205-274.
3. Thakur G, Kandakure V, Lahane V, Mishra S, Narkhede P. Pre-operative and post-operative

- audiometric evaluation in chronic otitis media. *IOSR J Dent Med Sci*. 2015;14(9):33-35.
4. Artono, Ahadiyah TH, Rahmawati R, Purnami N, Handoko E. Profile of chronic suppurative otitis media complication in Indonesian Patients: Review of 25 cases. *Syst Rev Pharm*. 2020;11(11):1477-1481.
5. Shinta N, Purnami N, Ahadiyah TH. Study report: Association between pure tone average and ossicular status in chronic suppurative otitis media. *J Phys Conf Ser*. 2018;1075:1-5.
6. Gupta S, Kalsotra P, Sehgal S, Gupta N. Review of parameters used to assess hearing improvement in tympanoplasty. *IOSR J Dent Med Sci*. 2016;15(2):122-128.
7. Rao SS, Rao BR, Nadimpalli MKR, Vatti N, Nirupama V. Comparative study of complications of type-I tympanoplasty in children versus adults. *J Evid Based Med Healthc*. 2019;6(8):501-504.
8. Babu MM, Ramabhadraiah AK, Srivastava T, Thirugnanmani R. Hearing improvement after type-III tympanoplasty: a prospective observational study. *Indian J Otolaryngol Head Neck Surg*. 2019;71(Suppl 2):1227-1231.
9. Sehra R, Rawat DS, Aseri Y, Tailor M, Chaudhary VK, Singh BK, *et al*. Post-operative sensorineural hearing loss after middle ear surgery. *Indian J Otolaryngol Head Neck Surg*. 2019;71(Suppl 2):1327-1333.
10. Deosthale NV, Khadakkar SP, Kumar PD, Harkare VV, Dhoke P, Dhote K, *et al*. Effectiveness of type-I tympanoplasty in wet and dry ear in safe chronic suppurative otitis media. *Indian J Otolaryngol Head Neck Surg*. 2018;70(3):325-330.
11. Bala K, Latoo MA. Evaluation of hearing outcome by single stage intact canal wall tympanomastoidectomy in patients with active squamous chronic otitis media: a prospective observational study. *World Wide Journals*. 2019;8(5):9-12.
12. Demirci S, Tuzuner A, Callioglu EE, Akdagli S, Karadas H, Caylan R. Tympanoplasty outcomes in elderly patients. *Auris Nasus Larynx*. 2016;43(1):33-36.
13. Kumar BYP, Gowda KMG, Pani MKV, Thanzeemunisa. Hearing outcome in canal wall down mastoidectomy with tympanoplasty. *J Evol Med Dent Sci*. 2015;4(32):5512-5517.
14. Ferriastuti W, Ramayuda IB. Radiological aspects of HR-CT scan on temporal bone. *Folia Medica Indones*. 2022;58(1):88.
15. Ridwan A, Husni TR T, Machilah N, Aria Z. Comparison of angle, length, and diameter of the eustachian tube of safe and unsafe CSOM based on CT scan in Dr. Zainoel Abidin General Hospital, Banda Aceh, Indonesia. *Bali Med J*. 2021;10(2):510-514.
16. Anil HT, Shree SS. Hearing improvement post type-I tympanoplasty retrospective study. *J Evid Based Med Healthc*. 2017;4(87):5086-5089.
17. Swamy KM, Ganiger A. Audiological evaluation in between patients with type-I tympanoplasty alone and type-I tympanoplasty with cortical mastoidectomy. *Int J Otorhinolaryngol*. 2017;4(1):45-49.
18. Hayati R, Haryuna TSH, Zahara D. Hearing threshold differences between pre and post tympanoplasty in patients with chronic suppurative otitis media. *Bali Med J*. 2018;7(1):47-50.



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