

## Correlation between Pure Tone Audiometry and Intraoperative Ossicular Chain Status in Mucosal Type of Chronic Otitis Media – A Hospital Based Case Series Study

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### Abstract:

**Introduction:** Chronic otitis media (COM) implies a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion. The aim of tympanoplasty done for mucosal COM is not only to achieve a dry ear, but also to give hearing improvement to the patient. Hence, factors causing ossicular discontinuity should be known before ossiculoplasty and guarded prognosis regarding their hearing improvement should be given.

**Objective:** To determine the correlation between pure tone audiometry and intraoperative ossicular chain status in mucosal type of chronic otitis media.

**Methods:** This case series study was done on 65 patients with COM mucosal disease. All patients were examined to know about tympanic membrane perforation and middle ear status. Preoperative pure tone audiometry (PTA) was done. All patients underwent tympanoplasty and intraoperative findings of ossicles were noted.

**Results:** Among 65 patients of COM mucosal disease, hearing loss increased with increased duration of the disease. The difference in hearing loss between intact ossicle group ( $31.02 \pm 5.14$  dBHL) and eroded ossicle group ( $49.79 \pm 7.61$  dBHL) and difference in air-bone gap (ABG) between intact ossicle group ( $20.13 \pm 4.46$  dB) and eroded ossicle group ( $33.62 \pm 5.25$  dB) were statistically significant ( $p < 0.01$  in both). The mean hearing loss and mean ABG were statistically significant between different eroded ossicles.

**Conclusion:** Hearing level and ABG are good indicators of ossicular defects in mucosal type of COM. Ossicular erosion should be suspected if the hearing loss  $> 49.79$  dB and air bone gap  $> 34.55$  dB.

**Keywords:** Tympanic Membrane Perforation, Mucosal Disease, Ossicular Erosion, Hearing Loss.

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### Introduction

Chronic otitis media (COM) implies a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion.[1] COM may result in several major and sometimes life-threatening complications such as hearing loss, meningitis, cerebral abscess, mastoiditis, facial paralysis, cholesteatoma, granulation and subdural empyema.[2]

COM is usually classified into two main groups; mucosal and squamosal disease. Mucosal type of COM is called safe type, because the rate of complication is very low and is usually not associated with cholesteatoma formation. Ossicular chain involvement is found in both safe and unsafe

type of disease. In safe type, though the involvement of ossicular chain is less common, still significant numbers of patients are having hearing deterioration due to it.[3] Hearing loss is due to disruption of the ear drum and ossicles assembly or from hair cell damage by the bacterial infection that has penetrated the inner ear (sensorineural hearing loss), or both (mixed hearing loss). Conductive hearing loss is the commonest type of hearing loss. Factors that influence the degree of conductive hearing loss are the size of the perforation, impairment of ossicular chain and presence of middle ear pathology such as edema, granulation tissue that influences the sound conducting mechanism.[4]

Malleus, incus and stapes along with tympanic membrane are vital for impedance matching mechanism of the middle ear. Discontinuity of ossicular chain is typically confirmed only at surgery but various preoperative parameters are described in studies that can predict the presence of ossicular erosion.[5] Tympanoplasty is a surgical procedure performed to eradicate infection and restore the function of the middle ear. The aim of tympanoplasty done for mucosal type of COM is not only to achieve a dry ear, but also to give hearing improvement to the patient.[6]

Pre-operative evaluation of ossicular discontinuity enables surgeon to plan for longer duration of surgery, requirement of ossicular replacement prosthesis for ossiculoplasty in addition to type 1 tympanoplasty and patients can be informed of the realistic estimate of hearing improvement after surgery.

**Objective:** To determine the correlation between pure tone audiometry and intraoperative ossicular chain status in mucosal type of chronic otitis media.

## Materials and Methods

### Study Design

Prospective case series clinical study.

**Study Period:** The present study period was from January 2019 to June 2020.

**Study Population:** The study Population included patients of chronic otitis media, mucosal disease from OPD of department of Otorhinolaryngology and Head & Neck surgery of S. Nijalingappa medical college and HSK hospital, Bagalkot, Karnataka.

**Sample Size:** Sample size estimation was done using Open epi software version 2 at 95% confidence level. According to the study conducted by Dudda R et al[7] the intact ossicular chain is seen in 78.84 % patients that is 'p'. Sample size estimated was 65.

Formula used is  $n = [DEFF * Np(1-p)] / [d^2 / z^2 - 1 - a/2 * (N-1) + p * (1-p)]$

**Inclusion Criteria:** Patients of age above 18 years of both gender with unilateral/bilateral chronic otitis media mucosal type with no history of ear discharge for atleast 6 weeks and with minimal to moderately severe hearing loss upto 60 dB loss were included in the study.

**Exclusion Criteria:** Patients with COM squamosal type; the patients who have been operated in the same ear; Patients with active disease with persistent ear discharge.

Patients with tympanic membrane perforation due to other causes such as trauma, tuberculosis etc; patients with complications of COM and patients with hearing loss >60 dB.

**Ethical Considerations:** The Institutional Ethical Committee approved the study.

**Method of Collection of Data:** All patients were explained the nature of the study and informed consent was taken. A detailed history was taken in each case and patients underwent detailed ENT examination. Patients were evaluated by otoscope and otomicroscope to know the tympanic membrane perforation, presence of polypoidal middle ear mucosa and granulation tissue in the middle ear. Preoperative pure tone audiometry was done was done using Amplaid diagnostic type 4 audiometer by modified Hughson-Westlake method to know the degree and type of hearing loss in dB. Average AC threshold was calculated at 500, 1000 and 2000 Hz. Air bone gap was calculated as an average at 500Hz, 1000Hz and 2000Hz. Intraoperative ossicular chain status such as erosion and discontinuity are observed and correlated with degree of hearing loss.

**Statistical Analysis:** The data was analyzed statistically by OpenEpi software version 2. For quantitative data, t – test and ANOVA are used. P<0.05 is considered as statistically significant.

## Results

**Table 1: Age distribution**

| Age (years) | Number of Patients | Percentage (%) |
|-------------|--------------------|----------------|
| 18 – 30     | 46                 | 70.77          |
| 31 – 40     | 13                 | 20             |
| 41 – 50     | 3                  | 4.61           |
| 51 – 60     | 3                  | 4.61           |

**Table 2: Side affected**

| Side Affected | Number of Patients | Percentage (%) |
|---------------|--------------------|----------------|
| Unilateral    | Right              | 29.23          |
|               | Left               | 46.15          |
| Bilateral     | 16                 | 24.62          |

**Table 3: Duration of disease with degree of hearing loss**

| Duration   | Minimal<br>(16-25) | Mild<br>(26-40) | Moderate<br>(41-55) | Moderately severe<br>(56-70) | Total |
|------------|--------------------|-----------------|---------------------|------------------------------|-------|
| < 10 years | 2                  | 21              | 13                  | 5                            | 41    |
| > 10 years | 1                  | 5               | 10                  | 8                            | 24    |
| Total      | 3                  | 26              | 23                  | 13                           | 65    |

**Table 4: Duration of disease with mean hearing level and mean ABG (Air-Bone gap)**

| Duration of Disease | Hearing Loss<br>(Mean $\pm$ Standard deviation) | AB Gap<br>(Mean $\pm$ Standard deviation) |
|---------------------|-------------------------------------------------|-------------------------------------------|
| <10 years           | 39.93 $\pm$ 10.98                               | 27.35 $\pm$ 9.02                          |
| $\geq$ 10 years     | 47.86 $\pm$ 10.37                               | 32.42 $\pm$ 7.87                          |
| p value             | < 0.01                                          | < 0.01                                    |

**Table 5: Hearing level and ABG in intact and eroded ossicle group**

| Ossicles | Number | Hearing Level (dB)<br>(Mean $\pm$ Standard deviation) | AB Gap (dB)<br>(Mean $\pm$ Standard deviation) |
|----------|--------|-------------------------------------------------------|------------------------------------------------|
| Intact   | 24     | 31.02 $\pm$ 5.14                                      | 20.13 $\pm$ 4.46                               |
| Eroded   | 41     | 49.79 $\pm$ 7.61                                      | 34.55 $\pm$ 6.05                               |
| p value  |        | < 0.01                                                | < 0.01                                         |

**Table 6: Various ossicles eroded with mean hearing loss and mean air bone gap**

| Eroded ossicle (frequency) | Hearing level (dB) | AB gap (dB)      |
|----------------------------|--------------------|------------------|
| Isolated malleus (7)       | 42.96 $\pm$ 3.44   | 29.79 $\pm$ 4.69 |
| Isolated incus (24)        | 49.41 $\pm$ 7.66   | 34 $\pm$ 5.98    |
| Isolated stapes (0)        | 0                  | 0                |
| Malleus+ Incus (7)         | 53.5 $\pm$ 5.09    | 37.86 $\pm$ 3.63 |
| Malleus+ Incus+ Stapes (3) | 60 $\pm$ 0         | 42 $\pm$ 1.53    |
| p value                    | < 0.01             | < 0.01           |

All patients with chronic otitis media mucosal disease in the age group 18 – 60 years fulfilling the criteria as specified were included in the study. Of the 65 patients, the maximum patients were in the age group of 18 – 30 years with 70.77% and 20% in the age group of 31 – 40 years. The mean age was  $28 \pm 9.58$  years. Females (64.66%) were more than males (35.38%) with the male to female ratio 1:1.8 in this study. Bilateral discharge was seen in 16 (24.62%) cases and unilateral discharge was seen in 19 (29.23%) cases on right side and 30 (46.15%) cases on left side.

In this study, 41 cases (63.08 %) had disease for duration less than 10 years and 24 cases (36.92 %) had disease for more than 10 years duration. Patients with disease more than 10 years commonly had moderate (41.67 %) and severe degree hearing loss (33.33 %). The difference in mean hearing level and mean ABG value between 2 groups based on duration of disease was statistically significant (p value- 0.005 and 0.025 respectively).

The mean hearing level (HL) was  $31.02 \pm 5.14$  dB and  $49.79 \pm 7.61$  dB in patients with intact ossicular chain (24 cases, 36.92%) and ossicular discontinuity (41 cases, 63.08%) respectively (p = 0.0001). The mean ABG was  $20.13 \pm 4.46$  dB and  $34.55 \pm 6.05$  dB in patients with intact ossicular chain and ossicular discontinuity respectively and the mean (P = 0.0001).

Erosion of all 3 ossicles was associated with maximum hearing loss (mean HL  $60 \pm 0$  dB, mean ABG  $42 \pm 1.53$  dB). Least hearing loss (mean HL  $42.96 \pm 3.44$  dB, mean ABG  $29.79 \pm 4.69$  dB) in ossicular chain eroded cases was seen in cases with isolated malleus erosion (erosion of handle of malleus). The mean hearing loss and mean ABG were statistically significant between different eroded ossicles (p value, 0.002 and 0.005 respectively).

### Discussion

Of the 65 patients, 18 – 30 years is common age group of presentation. The mean age was  $28.7 \pm 9.58$  years. Raushan EA et al[8] observed similar findings in study on 110 patients, with a mean age of 27.17 years and maximum number of cases were found to be in the second and third decade. In a study done by Ibekwe TS et al,[9] male to female ratio was 1: 1.8 (male – 22, female – 40) and 15 cases (24.2%) had bilateral TM perforations, 21 cases (33.9%) had right unilateral and 26(41.9%) left unilateral tympanic membrane perforations. This is comparable with this study.

The difference in mean hearing level and mean ABG value from PTA between 2 groups based on duration of disease was statistically significant in this study. Maharjan M et al[10] also observed statistically significant difference between various degrees of hearing loss between 2 group divided as duration

less than 10 years and more than 10 years ( $p$  value – 0.023). This is comparable with our study. In a study done by Priyadarshini G et al,[11] it is shown that degree of hearing loss increases with duration of the disease. 68.8% of the patients with longer duration of discharge i.e, more than 30 years, had moderately severe hearing loss and 60.2% of the patients having shorter duration of discharge i.e., less than 10 years, had mild hearing loss.

In this study there is statistically significant difference between intact ossicular chain and eroded ossicular chain in terms of mean hearing level and ABG. The results of our study is comparable to a prospective study of Srinivas C et al[12] on 47 patients of COM tubotympanic disease, the mean HL was  $46.2 \pm 20.1$  dB and  $65.7 \pm 14$  dB in patients with intact ossicular chain and ossicular discontinuity respectively ( $p = 0.04$ ). The mean ABG was  $23.9 \pm 9.8$  dB and  $35.1 \pm 10.3$  dB in patients with intact ossicular chain and ossicular discontinuity respectively and the mean ( $p = 0.001$ ). In a study by Dudda R et al[7], the difference in the mean HL and mean ABG between intact ossicle group and eroded ossicle group were statistically significant ( $p = 0.002293$  and  $p = 0.04$  respectively). The cross-sectional study done by Das D et al[13] recommends that PTA can be used as an effective screening tool to assess the status of ossicles. The study showed a statistically significant difference between the hearing levels between ossicular chain intact and eroded groups in the frequencies of 500Hz, 1000Hz, 2000Hz and 4000Hz ( $p < 0.001$  each in all above mentioned frequencies). Hence HL and ABG are good indicators of ossicular defects in mucosal type of COM.

Incus was the most common eroded ossicle in our study, followed by malleus. The mean HL and mean ABG were statistically significant between different eroded ossicles. In the study of 200 patients by Rout MR et al[14] long process of incus was associated with maximum number of cases (17) and average hearing loss was 50.2 dB. Long process of incus and superstructure of stapes was seen in seven cases and hearing loss was 57.1 dB. Average hearing loss was maximum when all the three ossicles were absent (3 cases, 58.4 dB). Hearing loss was minimum with isolated malleus handle involvement (2 cases, 45 dB). In a study by S Gurumani[15] on 150 cases, the average hearing loss in patients with isolated loss of incus was  $59.58 \pm 1.77$  dB. In patients with erosion of handle of malleus and the long process of incus, the average hearing loss was  $39.38 \pm 5.15$  dB. But hearing loss was higher in patients with erosion of handle of malleus and absence of incus ( $53.73 \pm 7.05$  dB). The hearing loss was highest in patients with absence of incus and stapes superstructure (60 dB). In a prospective study by Saboo R et al[16] on 150 cases, it was seen that hearing loss was minimum with isolated handle of malleus

involvement and maximum when all three ossicles were absent.

## Conclusion

In chronic otitis media mucosal disease, the hearing level and air bone gap are good indicators of ossicular defects. The ossicular erosion should be suspected if the hearing loss is more than 49.79 dB and air bone gap is more than 34.55 dB. Incus is the most commonly eroded ossicle and stapes is the least commonly eroded ossicle. Erosion of all the three ossicles results in maximum conductive hearing loss.

If pre-operative information can be used to determine whether or not the ossicular chain is intact and can influence surgical decision making, the patient can be better informed and the surgeon can be better prepared for surgery.

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