

A Descriptive Study Assessing the Correlation between the Size of Holes in the Tympanic Membrane and the Degree of Hearing Loss

Paromita Patra^{1*}, Windeep Singh Waan¹, Barun Kumar Bhattacharjee¹, Surbhi Malik¹

1. Department of Otorhinolaryngology, MGMMC & LSK Hospital, Kishanganj, Bihar, India

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Corresponding Authors:

Dr. Paromita Patra

Email:

research.gorki@gmail.com

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Abstract

Background: Holes in the tympanic membranes, known as perforations, are a common ear condition often resulting from trauma, infection, or medical procedures. These perforations can lead to various degrees of hearing loss and require timely detection and treatment to prevent further damage to the middle ear.

Aim: This study aimed to investigate the correlation between the size of perforations in the tympanic membrane and the degree of hearing loss. Specifically, the study categorized the perforations into small, medium, and large sizes to assess their impact on hearing function.

Methods: The study conducted an observational analysis of 1000 patients (1230 ears) with chronic otitis media, focusing on those aged between 16 to 45 years. Patients with central perforations in the pars tensa were included, while those with squamosal chronic suppurative otitis media or wet ear were excluded. Data collection included detailed medical history, general examination, ENT examination, and assessment of perforation size using otoendoscopy. Pure-tone audiometry was utilized to measure hearing loss, categorized according to WHO standards. Statistical analysis was performed to determine the correlation between perforation size and hearing loss.

Results: Of the 1000 patients included, 23% had bilateral perforations, with varying sizes observed. The majority of patients had mild conductive hearing loss (69.9%), followed by moderate (27.6%) and severe (1.6%) loss. The analysis revealed a significant correlation between perforation size and hearing loss ($p < 0.05$). Smaller perforations were associated with mild hearing loss (averaging 28 dB), while larger perforations led to more severe loss (averaging 47 dB).

Conclusion: The study confirmed that the size of perforations in the tympanic membrane correlates with the degree of hearing loss, with larger perforations resulting in more significant impairment. These findings underscore the importance of early detection and appropriate management of tympanic membrane perforations to prevent further hearing deterioration. However, future research should consider additional factors such as patient age and the condition of the middle ear bones to provide a comprehensive understanding of hearing outcomes in these cases.

Conflicts of Interest: The Authors declare no conflicts of interest.

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Introduction

The eardrum is about 9–10 millimeters tall and 8–9 millimeters wide. It acts like a barrier between the ear canal and the middle ear. It has a significant impact on the mechanism that

controls the middle ear transformer. The most common type of holes in the eardrum are perforations or holes in the pars tensa. Our study specifically looks at these types of

perforations in the eardrum. For a variety of reasons, including trauma, infection, or medical operations, holes in the tympanic membranes may develop. Therefore, it is essential to both detect and treat the formation of holes in the tympanic membrane of the ear as soon as feasible. This is because, if left untreated, holes in the tympanic membrane may lead to continued damaging changes in the middle ear, which can contribute to further hearing loss (2). Chronic otitis media is when the lining of the middle ear is inflamed. This can affect part or all of the lining. It's a common condition that affects many people. In addition to being the most prevalent cause of perforation in the tympanic membrane, CSOM is also possible to be the condition that is encountered the most often in an ENT clinic (3). CSOM affects thirty percent of the patients who take care of themselves in the outpatient section of the ENT (3). Nearly all cases of hearing loss are related with infections of the middle ear, which are mostly of a conductive character (4). A key contributor to conductive deafness is CSOM, which is a condition that affects the ear canal (5). When it comes to finding a diagnosis and providing treatment for these disturbances, clinical challenges may arise. Although it is not difficult to recognize a hole, the size of the perforation is an essential component in determining the auditory effects that are produced as a consequence of the perforation. Specifically, the purpose of this research is to investigate the complex link that exists between the extent of holes in the tympanic membranes and the effect that they have on hearing function.

Methods

Aims and Objectives of the Study

- To classify the pars tensa perforations into small, medium and large as per the size.
- To assess how much and what kind of hearing problems people have when they have holes in the eardrum's pars tensa.
- To examine how the size of the holes in the eardrum relates to how much hearing is lost.

Inclusion Criteria

- Patients aged between 16 and 45 years of any gender.
- Patients with central perforation in pars tensa.

Exclusion Criteria

- Patients with squamosal CSOM.
- Patients with wet ears.

From January 2023 to December 2023, data was collected from 1000 patients (1230 ears) at the ENT Department's OPD in MGM & LSKH, KISHANGANJ BIHAR, INDIA, who had chronic otitis media. After obtaining consent, a detailed medical history, general examination, and ENT examination were conducted. The size of the perforations was carefully determined using otoendoscopy, classifying them as small, medium, or large. Small perforations involved less than 25% of the pars tensa, medium involved 25 – 50%, and large involved more than 50%. Different surgeons conducted the evaluations, but they all followed the same method. Pure-tone audiometry was used to measure the degree of hearing loss, classified according to the World Health Organization's (WHO) standards (mild: 21-40 dB, moderate: 41-60 dB, severe: 61-80 dB, profound: above 80 dB) (8). Demographic information, such as age and gender, was also recorded.

Through the use of the Pearson correlation coefficient, statistical analysis was carried out to determine the degree of association between the size of tympanic membrane perforations and the degree of hearing loss. In this example, the approach assesses the magnitude and direction of the linear relationship between the perforation size and the degree of hearing loss, two continuous variables. There is a perfect negative linear relationship when the Pearson correlation coefficient is -1, a perfect positive linear relationship when it is 1, and no linear relationship at all when it is 0.

To determine if the observed correlation coefficient is statistically significant, the p-value was computed. It is highly improbable that the observed link happened by chance, as a significance level of $p < 0.05$ was deemed statistically significant.

The study provided important insights into the effect of perforation size on auditory function by objectively assessing the association between tympanic membrane perforation size and degree of hearing loss using the Pearson correlation coefficient.

Results

The total number of patients included in the study was 1000 out of which 23% had bilateral holes in the tympanic membrane, 36% had left holes in the tympanic membrane and 41% had right holes in the tympanic membrane, thus, leading to the inclusion of 1230 ears in the study (Figure 1). 55% of these patients were males and 45% were females. The sizes of

Holes in the tympanic membranes varied, with 25%, 38%, and 37% falling into the small, medium, and large categories, respectively. On evaluating the hearing loss in these patients 69.9% had mild conductive hearing loss, 27.6% had moderate and 1.6% had severe conductive hearing loss, no patient showed any profound hearing loss. Statistical analyses (paired t-test) found a significant link between the size of the hole in the eardrum and how much hearing was lost ($p < 0.05$). Smaller perforations were typically associated with mild hearing loss, medium-sized perforations with moderate loss, and larger perforations with severe hearing loss. Small holes in the tympanic membranes were often associated with mild hearing loss averaging 28 db. Holes in the tympanic membranes of medium size were associated with moderate hearing loss, averaging 36 db. In contrast, large holes in the tympanic membranes resulted in severe hearing loss, averaging 47 db.

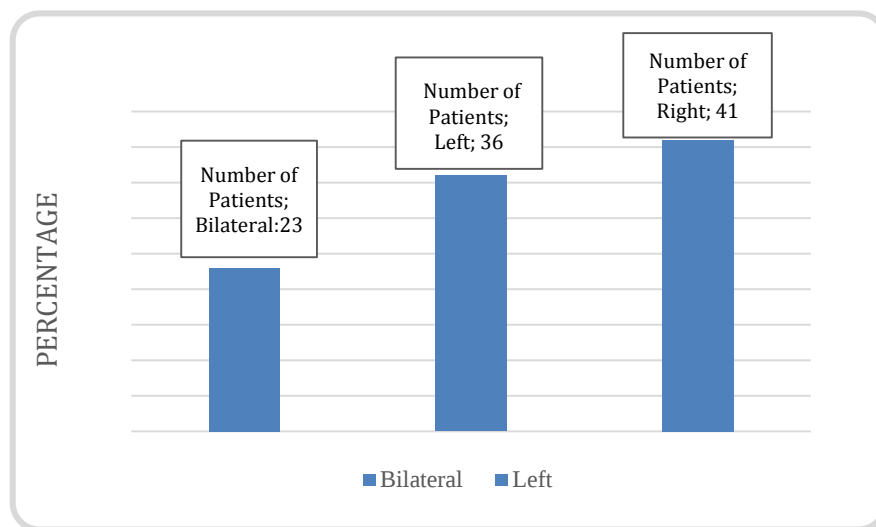


Figure 1. Number of cases

The analysis revealed important correlations between tympanic membrane perforation size and hearing loss severity. Our statistical analysis (Pearson correlation coefficient = 0.75, $p < 0.001$) revealed a strong association between these characteristics. This correlation coefficient shows a strong positive linear relationship between greater perforations and

worsening hearing loss. Our investigation indicated a clear link between larger holes and worse hearing loss. It appears that larger perforations are associated with greater hearing loss. A correlation value of 0.75 underlines the strong relationship between hole size and hearing loss severity.

Our findings are highly significant ($p < 0.001$), indicating that the observed correlation is unlikely to be due to chance. The great statistical significance of our data lets us trust it and make the proper conclusions. These findings highlight the need early detection and therapy of tympanic membrane perforations in clinical practice. Healthcare practitioners can prioritise interventions and therapies for individuals with larger perforations by studying the relationship between perforation size and hearing loss severity. This reduces the risk of gradual hearing loss.

The study illuminates the complex link between tympanic membrane perforation and hearing loss severity. Through rigorous statistical analysis, we showed that prophylactic interventions to heal tympanic membrane perforations protect auditory function.

Discussion

The researchers investigated whether and how eardrum hole size affects audibility. They looked at 1000 patients (1230 ears) with these holes and found that the bigger the hole, the worse the hearing loss. This helps doctors understand ear problems better and treat them more effectively. In their study, they found that 25% of the holes were small, 38% were medium, and 37% were large, showing how different each person's situation can be. They also saw that as the hole size increased, so did the hearing loss. Small holes caused mild hearing loss (averaging 28 dB), medium holes caused moderate hearing loss (averaging 36 dB), and large holes caused severe hearing loss (averaging 47 dB). Other studies have also shown that bigger holes lead to more hearing loss. For example, Morris J et al. found that in Aboriginal Australian children, larger holes meant greater hearing loss, regardless of where the hole was located. Another study found that as the hole size increased, so did the degree of hearing loss, especially at lower frequencies. Overall, these studies emphasize the importance of understanding how hole size

affects hearing loss to better treat ear problems. Pannu K, et al. conducted a study (2) to see how holes in the eardrum affect hearing. They found that as the holes got bigger, the hearing loss increased at all frequencies. Comparing the average hearing loss in different groups showed a big difference. The average hearing loss was higher in people with larger holes.

Conclusion

Our study confirms that small holes in the eardrum cause less hearing loss than larger ones. However, we didn't consider the patient's age or other factors like the condition of the tiny ear bones that can also affect hearing. We plan to address this gap in future research.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Patients' Consent

Verbal Consent was taken before the examination of the ear in the OPD of MGM medical college and LSK Hospital Kishanganj Bihar.

Authors ORCIDs

Paromita Patra

<https://orcid.org/0009-0007-2975-1181>

Windeep Singh Waan

<https://orcid.org/0009-0000-5635-5386>

Barun Kumar Bhattacharjee

<https://orcid.org/0009-0002-1904-4698>

Surbhi Malik

<https://orcid.org/0000-0002-5184-0240>

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