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The Sound of Silence: A Study on Tympanic Membrane Perforation and Its Effects on Hearing in Chronic Otitis Media

Dr. Rajendra B Metgudmath[1], Dr. Rahul Gulaganji[2]

[1]Professor, Department of ENT & Head and Neck Surgery, J.N. Medical College, KAHER, Belagavi, Karnataka
[2]Junior Resident, Department of ENT & Head and Neck Surgery, J.N. Medical College, KAHER, Belagavi, Karnataka

Corresponding Author: Dr. Rahul Gulaganji

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ABSTRACT

Introduction: The ear is a sensory organ that picks up sound waves, allowing us to hear. Hearing loss in COM can result from TM perforation. It is generally accepted that severity of hearing loss and site of perforation is connected. Nevertheless, there are several contradictory studies addressing hearing loss related to size and site of TM perforation. Hence, this study is done to correlate the size and site and of TM perforation and to assess impact on the types and degree and of hearing loss in patients with COM.
Objective: The objective of the study was to correlate hearing loss with size and site in TM perforation and to assess its impact with types and degree of hearing loss in patients of COM.
Methods: It was a one-year observational study. The study included a total of 113 ears with TM perforation patients of both sex and between group of 18-60 years. Size of TM perforation was measured using Image J software. Site of TM perforation was assessed using Otoendoscopic examination. Each patient underwent PTA and ENT examination.
Results: Hearing loss was more with increased size of perforation. Hearing loss was comparatively more when perforations were located in the Posterosuperior quadrant. There is a significant association with degree hearing loss and of size of perforation. The degree of hearing loss increases with increased size of the perforation.
Conclusion: Thus, the study shows significant correlation between size and site of TM perforation with the types and degree of hearing loss.

KEYWORDS: Size, Site, Tympanic membrane, COM.

INTRODUCTION

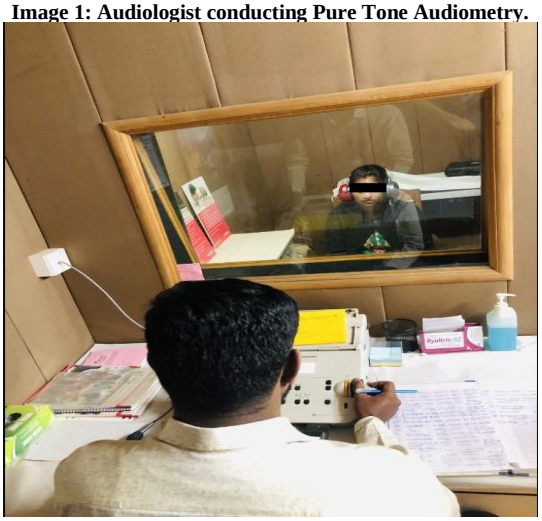
Chronic Otitis media (COM) is a chronic infection of middle ear cavity and perforated tympanic membrane with discharge of a minimum of 6 weeks. India has highest (>4%) prevalence group for the burden of COM, according to a WHO classification.[1] The size and site of the TM perforation and the dysfunction of the ossicular chain are the elements that determine the type and degree of hearing loss.[2] Several clinical investigations have been carried out recently in COM patients to know the correlation with hearing loss with characteristics of perforation, such as size and site, but the results were found to be ambiguous and contradictory.[1] This study is done to correlate the size and site of the TM perforation and to assess impact on the types and degree of HL in patients with COM.

Aim and Objective: To assess the type and degree of hearing loss with the size and site of tympanic membrane perforation.

MATERIALS AND METHODS

An observational study was conducted on 113 ears from 95 patients with tympanic membrane perforation between the age group of 18-60 years willing to undergo ENT examination, Otoendoscopic examination and PTA (Image 1) between January and December 2021. Instruments used for data collection are Welch Allyn otoscope, MAICO^{TM} MA53 audiometer and Karl Storz 0-degree endoscope.

Image 1: Audiologist conducting Pure Tone Audiometry.



The following exclusion criteria for both were applied during participant selection:

1. Presence of granulation tissue or mucosal oedema.
2. Presence of ossicular chain disruption and cholesteatoma.
3. Active ear discharge of COM, SNHL, atticoantral type of COM.
4. Patients not willing to give written and informed consent.

Informed consent was obtained from all participants in this study.

The study protocol was approved by the ethics committee JNMC institutional Ref: MDC/DOME/65 dated on 25/01/2021.

After taking informed consent from the patient, their details and a thorough clinical history were obtained including the duration of HL. All patients were clinically examined including general physical examination and careful examination of the ear, nose and throat. Oto-endoscopic examination was done using zero-degree endoscope to assess the size and site of perforation in pars tensa of TM. The site of the perforation was noted whether anterior or posterior to handle of malleus. The photography of the perforation was taken and size was measured using "IMAGE J" software. Pixel measurements were used to determine the size of the perforation and the overall size of the tympanic membrane. The ratio of area of the perforation (P) (Image 2) to area of the tympanic membrane (Q) (Image 3) was calculated as percentage using the formula P/Q×100.

Hearing assessment was done with MAICO^{TM} MA53 audiometer at frequencies of 125-8000 Hz for air conduction and 250-4000 Hz for bone conduction.

Image 2: Image showing the area of perforation(P)

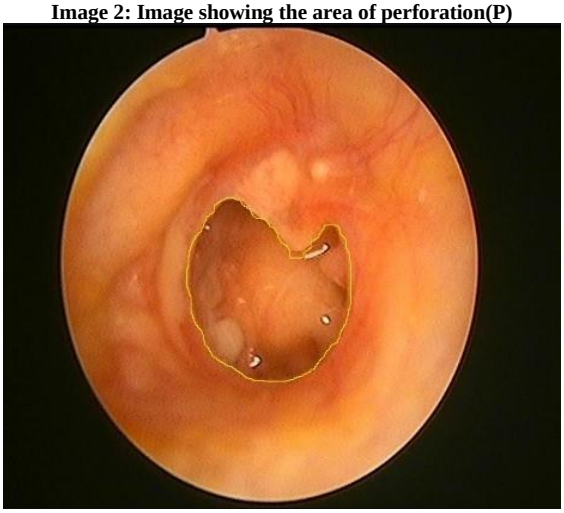
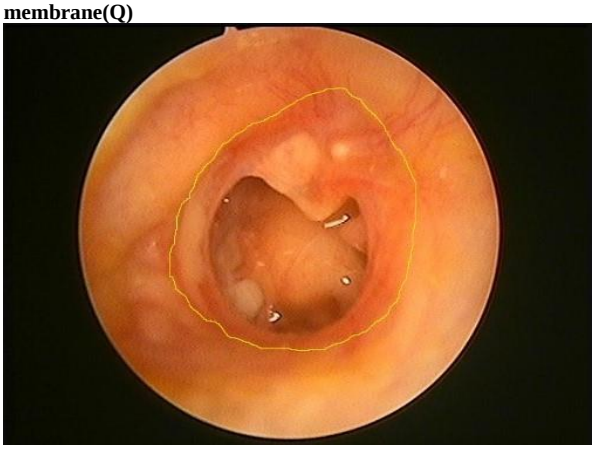


Image 3: Image showing the total area of the Tympanic membrane(Q)



STATISTICAL ANALYSIS

SPSS Software (20th version) was used for statistical evaluation. The association between the outcome, clinical and demographic characteristics was tested using Chi-square test.

For all the tests the value of *p* less than 5% (0.05) will be considered significant.

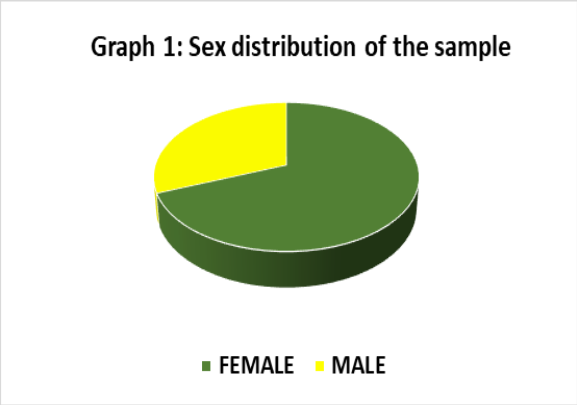
RESULTS

A total of 113 ears with tympanic membrane perforation from 95 patients in either or both ears were studied. All observations recorded in the study are described under the following headings.

Sex distribution: There were 35 males (30.97%) and 78 females (69.03%). (Table 1) (Graph 1)

Table 1- Sex distribution of the sample

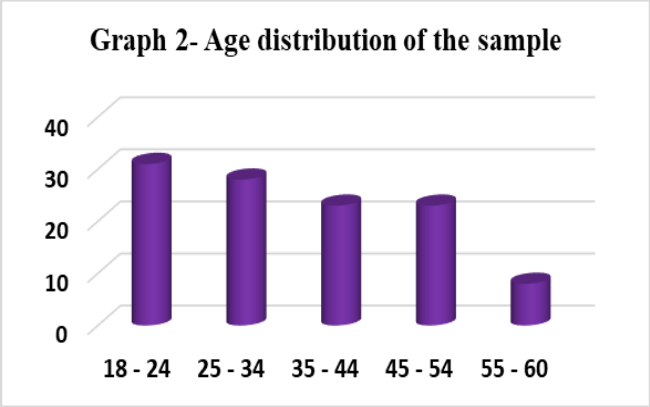
Gender	Number	%
Female	78	69.03
Male	35	30.97
Total	113	100.00



Age distribution of the sample: Ages ranged from 18 – 60 years, with a mean age of 35.46 ± 12.12 years. (Table 2) (Graph 2)

Table 2- Age distribution of the sample.

Age	Number	%
18 - 24	31	27.43
25 - 34	28	24.78
35 - 44	23	20.35
45 - 54	23	20.35
55 - 60	8	7.08
Total	113	100.00
Mean	35.46	
S.D.	12.12	



Distribution of type of hearing loss with size of the perforation.

Overall, conductive hearing loss was more common in 80 patients (70.80%). In small central perforations, conductive hearing loss was more common and in large central perforations mixed hearing loss was more common. (Table 3)

Table 3: Distribution of type of hearing loss with size of the perforation.

Size	Type of hearing loss				
	Conductive	%	Mixed	%	Total
Small	43	89.58	5	10.42	48
Medium	29	65.91	15	34.09	44
Large	8	38.10	13	61.90	21
Total	80	70.80	33	29.20	113

The value of p using chi-square test is 0.0001.

Distribution of degrees of hearing loss with site of the perforation.

The commonest hearing loss in anterior located perforation was Mild hearing loss. The commonest hearing loss in posterior located perforation was Moderate hearing loss. Overall, the hearing loss was more in severity when perforation was located in the posterior quadrant and on further analysis, among the posterior quadrant perforations hearing loss was comparatively more when perforations were located in the postero-superior quadrant than when located in the postero-inferior quadrant. (Table 4) (Graph 3)

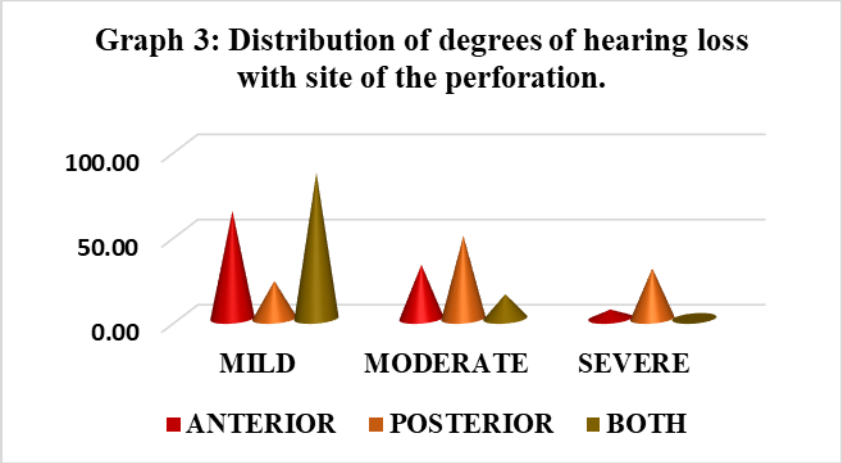


Table 4: Distribution of degrees of hearing loss with site of the perforation.

Site	Degrees of hearing loss						
	Mild	%	Moderate	%	Severe	%	Total
Anterior	24	63.16	12	31.58	2	5.26	38
Posterior	15	22.06	33	48.53	20	29.41	68
Both	6	85.71	1	14.29	0	0.00	7
Total	45	39.82	46	40.71	22	19.47	113

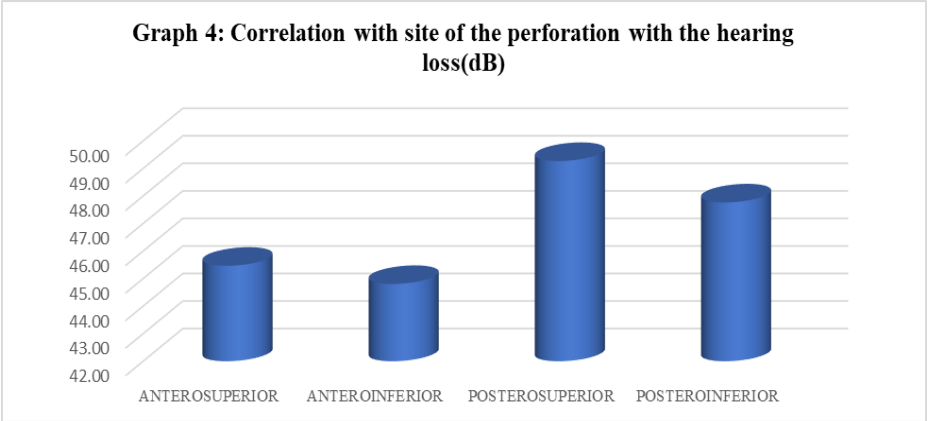
The value of p using chi-square test is less than 0.0001

Correlation with site of the perforation with the hearing loss(dB)

The highest hearing loss is seen in posterosuperior quadrant with the mean hearing loss of 49.27dB. However, there is very minimal difference of the mean value of 1.5dB with posteroinferior quadrant. (Table 5) (Graph 4)

Table 5: Correlation with site of the perforation with the hearing loss(dB)

Quadrant	Hearing loss(dB)			
	Mean	S.D.	Min	Max
Anterosuperior	45.47	13.52	21	86
Anteroinferior	44.81	14.20	20	86
Posterosuperior	49.27	12.78	28	86
Posteroinferior	47.77	13.99	20	86



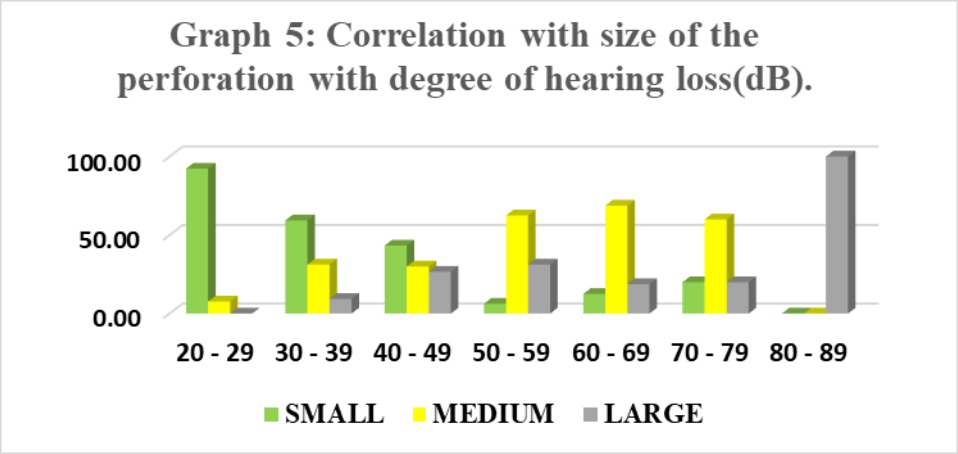
The value of p for the above table, using one way analysis of variance, is 0.0491.

Correlation with size of the perforation with degree of hearing loss(dB).

There is a significant association between the degree hearing loss (dB) and the of size of perforation. The degree hearing loss (dB) increases with the increased size of perforation. (Table 6) (Graph 5)

Table 6: Correlation with size of the perforation with degree of hearing loss(dB).

PTA (dB)	Size of perforation						Total
	Small 0-24 (%)	%	Medium 25 - 49 (%)	%	Large ≥ 50 (%)	%	
20 - 29	12	92.31	1	7.69	0	0.00	13
30 - 39	19	59.38	10	31.25	3	9.38	32
40 - 49	13	43.33	9	30.00	8	26.67	30
50 - 59	1	6.25	10	62.50	5	31.25	16
60 - 69	2	12.50	11	68.75	3	18.75	16
70 - 79	1	20.00	3	60.00	1	20.00	5
80 - 89	0	0.00	0	0.00	1	100.00	1
TOTAL	48	42.48	44	38.94	21	18.58	113



The value of p using chi-square test is 0.0001.

DISCUSSION

Hearing loss is a nationwide problem with significant physical and psychosocial problem, so it is very important to diagnose the perforation of tympanic membrane. Infections like acute otitis media, chronic otitis media, tuberculosis, trauma like barotrauma, temporal bone fracture, iatrogenic (ventilation tubes). Perforation size is an important determinant of the hearing loss; larger perforations result in larger hearing losses, more so when located in Postero inferior quadrant.

The present study is done to assess hearing status in patients with tympanic membrane perforation and its correlation with the size and site of the tympanic membrane perforation.

In our study, 93 patients with 113 ears with perforation of tympanic membrane were examined. Tympanic membrane perforation was seen in female predominance in 78 ears (69.03%) and in male, 35 ears (30.97%). The majority of patients were seen in the age group of 25 – 34 years. This showed that the youths were more socially active and aware of the social implications of HL.

Large central perforation was seen most commonly seen in 56 ears (49.56%) i.e. 31 left ears and 25 right ears with the mean size ranging from 43.48% ± 12.48% followed by Medium central perforation seen in 37 ears (32.74%) i.e. 23 left ears and 14 right ears with the mean size ranging from 22.27% ± 11.31% followed by Small central perforation seen in 20 ears(17.70%) i.e. 11 left ears and 9 ears with the with the mean size ranging from 16.65% ± 19.69%.

Conductive hearing loss was the most commonly seen in 80 ears (70.79%) with Mild Conductive hearing loss seen in 44 ears, Moderate Conductive hearing loss seen in 28 ears, Moderate severe Conductive hearing loss seen in 4 ears and Severe Conductive hearing loss seen in 4 ears. Mixed hearing loss was seen in 33 ears (29.20%) with Mild Mixed hearing loss is seen in 8 ears, Moderate Mixed hearing loss is seen in 12 ears, Moderate severe Mixed hearing loss is seen 6 ears and Severe Mixed hearing loss is seen in 7 ears.

The highest hearing loss is seen in Postero superior quadrant (PSQ)with the mean hearing loss of 49.27dB followed by Postero inferior quadrant (PIQ) with the mean hearing loss of 47.77dB. There is a minimal hearing difference of mean hearing loss of 1.5dB. Hearing loss is less in Small central perforations and more in Large central perforations. The hearing loss increases with increased size in perforation.

In the present study, size of perforation is statistically significant with hearing loss and PSQ perforation showed greater HL. Nepal et al (2008)[7] in their study concluded that HL was found to be directly proportional to the size of perforation irrespective of their cause, which was statistically significant and perforations involving PIQ were found to have maximum HL.

According to Kumar et al (2011)[6] findings, in this respect could not confirm conclusively the view of all other investigators who stated that the site is an important determinant of the HL and more HL results from posterior perforations than from anterior ones.

According to Rana et al (2019)[3], perforations involving posterior half of TM showed more loss than those involving anterior or inferior half of membrane statistically which is similar to our study.

According to our study, perforations located in posterior quadrants has more SHL. Mehta et al (2006)[4] in their study concluded that the perforations in anterior versus posterior quadrants showed no significant differences in air-bone gaps at any frequency, although the anterior perforations had an average air-bone gaps that were smaller by 1 to 8 dB at the lower frequencies and HL will not depend on location of the TM perforation.

In the present study, severe degree of HL is seen in posterior quadrant located perforations. According to Bandaru et al(2019)[5] the study observed no significant difference in the magnitude of HL based on site of perforation of TM which implies that there is no significant relationship between the site of perforation and the degree of HL. Similar results were also shown by Sood As et al(2018)[10] and Ibekwe TS et al(2008)[8] who observed no relation between location of perforation and magnitude of HL.

Our study was similar to study conducted by Darad et al(2017)[9] where the HL was found to be more in posterior perforations and HL resulting from malleolar than non-malleolar perforation.

Our study was similar to the study conducted by Lavanya et al (2021)[11,] Dudda et al (2018)[12] and Mirza et al (2019)[14] concluded that HL increased with the size of perforation and with posterior location of TM perforation.

Sharma et al (2020)[13] noted that HL due to TM perforation is usually a CHL and greater the percentage of the surface area of the TM that is lost, more severe is the degree of deafness which was similar to study conducted by us whereas according to Sharma et al(2020)[13], amongst the perforations located in the inferior quadrants of the tympanic membrane, the ones located in the posteroinferior quadrant cause greater degree of deafness than the anteroinferior quadrant perforations but in our study the greater hearing loss was seen in posterosuperior quadrant.

CONCLUSION

We observed that the tubotympanic type of COM is more common in females with age ranging from 18-60 years.

Hearing loss is greater at lower frequencies than higher frequencies. With an increase in the perforation size, the hearing loss becomes severe. The hearing loss was seen maximum when all four quadrants of the TM was involved. The perforation of TM was found to be located at different sites. Site of perforation is also an important factor as posterior quadrant pars tensa perforations have greater hearing loss than anterior quadrant perforations. The hearing loss in our study is maximum when perforation is located in Posterosuperior quadrant and minimum in Antero inferior quadrant.

Significant auditory loss can be avoided if COM patients are detected early and treated appropriately.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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