ISSN: 0975-3583,0976-2833 VOL15, ISSUE 01, 2024

"CORRELATION OF SITE OF TYMPANIC MEMBRANE PERFORATION AND PURE TONE AUDIOMETRY"

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Abstract :

Background : Pure-tone audiometry can play an important role in predicting the severity of the hearing loss which will in turn reflect on the integrity of the tympano-ossicular system. It is a record that can be kept for future reference. This will help the surgeon in preoperative planning before middle ear surgeries. The patient can also be informed regarding their hearing status and counselled about the results of middle ear surgery. It also helps in assessing post-operative improvement.

Methods : A Prospective Study. 50 Patients selected on simple random selection technique with history of loss of hearing, attending E.N.T. outpatient department and patients referred from other departments in Vijayanagar Institute Of Medical Sciences combined group of Hospitals, Ballari, over a period of one and half year from November 2019 to May 2021.

RESULTS : In our study, in pars tensa most most common quadrant involved is posterosuperior 19pateints, anteroinferior 13pateints, anterosuperior 11patients , posteroinferior 7patients. Thus hearing loss is more in posterior perforations of tympanic membrane than in anterior perforation.

CONCLUSION: Overall this study has shown significant correlation between the site and the degree of hearing loss Hearing loss depends on the site of tympanic membrane perforation. Hearing loss is more in posterior perforation of tympanic membrane than in anterior perforation. As loss is more than 40dB, there is chance of involvement of ossicles. This preoperative knowledge can influence the surgical decision making and also help the surgeon be prepared for reconstruction of the hearing mechanism or ossiculoplasty.

KEY WORDS : TYMPANIC MEMBRANE PERFORATION, PARS TENSA, PARS FLACCIDA, PURE TONE AUDIOGRAM.

INTRODUCTION :

The hearing ability is an important sensory function for communication and better quality of life. The sense of hearing is important, not only to understand the expression of the people around, but also for proper development of speech and language.

Disorders affecting the hearing can be congenital or acquired. Yet, it is preventable and correctable condition in the above-mentioned categories, which demand attention. The leading cause of hearing loss in acquired disorders being Chronic otitis media (COM) , is both preventable and correctable to certain extent as well.

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Tympanic membrane perforations are associated with a varying degree of conductive hearing loss. The size of the perforation has direct correlation with the degree of conductive hearing loss.[1-10] The site is a subject of controversy especially in relation to the severity of conductive hearing loss and in this study it shows a significant association with posterior perforations ($p<0.0001$).

This study has tried to bring in the use of otoscope and to give tympanic membrane perforations, a more objective view in term of site.

The study conducted in tertiary teaching institute from NOV 2019 to MAY 2021. Total of 50 patient are selected as per inclusion criteria and recruited for study.
COM (Tympanic membrane perforation)is a very common disorder caused either by infection or trauma, resulting in decreased hearing. So, a meticulous examination, diagnosis and treatment of tympanic membrane perforation are necessary for the assessment and restoration of hearing loss.

MATERIALS AND METHODOLOGY :

After the approval from the Ethical Committee, this study was carried out in our tertiary care hospital. Patients were diagnosed as COM by detailed clinical history and through ear, nose, and throat examination. The total number of patients in the study was 50.Clinical findings including presence of TM perforation and site of perforation. The tympanic membrane can be divided into four quadrants with an imaginary line drawn vertically along the long process of the malleus and extending to the inferior annulus, along with a horizontal line at the umbo, thus divides into posterosuperior , posteroinferior,anteroinferior ,anterosuperior .Thus perforation in pars tensa is divided into posterosuperior , posteroinferior ,anteroinferior ,anterosuperior.

Audiometric assessment was performed by using a clinical audiometer which was calibrated according to International Organization for Standardization (ISO). The patient's hearing levels in decibel were assessed. "Hearing level" was taken as the mean air conduction threshold at 500 Hz, 1000 Hz and 2000 Hz.

INCLUSION CRITERIA

1. Patients with mucosal chronic otitis media.
2. Patients with acute otitis media and tympanic membrane perforations.
3. Patients with trauma limited to the external ear and tympanic membrane.

EXCLUSION CRITERIA:

a) Patients with Cases associated with Sensorineural hearing loss and mixed hearing loss.
b) Patients with inactive /active squamosal chronic otitis media(unsafe /atticoantral)
c) Cases associated with intracranial and extracranial complications.
d) Cases associated with Malignancies in ear.
e) Revision cases.

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f) Those patients with psychiatric illness, unconscious,uncooperative , not given consent

SAMPLE SIZE ESTIMATION

A total of 50 consecutive patients of chronic otitis media (mucosal and squamosal type) with conductive hearing loss ,from the period between November 2019 to May 2020, who were willing to participate in the study were taken as study subjects.

$$n = \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2}$$

Where
Z is the Z score
ε is the margin of error
N is population size
p is the population propotion

Statistical Analysis

Qualitative data represented in the form of frequency and percentage.

Quantitative data represented using mean & Sd. Unpaired t test was used to compare the mean difference between variables.

ANOVA was used for more than three group comparison. Tukey's multiple comparison was applied to assess the one to one comparison.

A P value of <0.05 was considered statistically significant.

IBM SPSS Version 28 for windows was used to do statistical analysis.

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RESULTS

Fifty patients who underwent pure tone audiometry for COM with central perforation were included in the study.

The age distribution of study subjects, the age range was from 18 years to 55 years. Majority of the patients were in the age group of <20 years (42%). Only one patient aged more than 50 years (2%).In our study maximum patients were in 2nd decade 21(42%) patients,3rd decade 17(34%)patients,4th decade 8(16%)patients, fifth decade 3(6%) and <50 years 1(2%)patient.

In our study there is maximum of left ear involvement in 33(66%)patients, and right ear in 17(34%) patients.

Table 1 – Table showing Otoscopic finding of tympanic membrane perforations.

TYMPANIC MEMBRANE	Frequency	Percentage
Anterosuperior	11	22.0
Anteroinferior	13	26.0
Posterosuperior	19	38.0
Posteroinferior	7	14.0
Total	50	100.0

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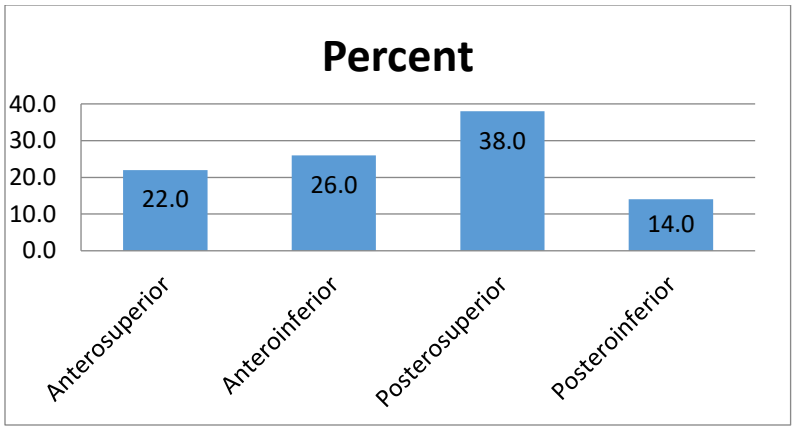

Graph 1– Bar diagram showing Otoscopic finding of tympanic membrane perforations.

In our study , in pars tensa most most common quadrant involved is posterosuperior 19pateints, anteroinferior 13pateints, anterosuperior 11patients , posteroinferior 7patients

Table 2 – Table showing Rinne's test findings in all cases of COM

RINNE'S TEST	NEGATIVE	PERCENTAGE
Mild	13	26.0
Moderate	33	66.0
Severe	4	8.0
Total	50	100.0

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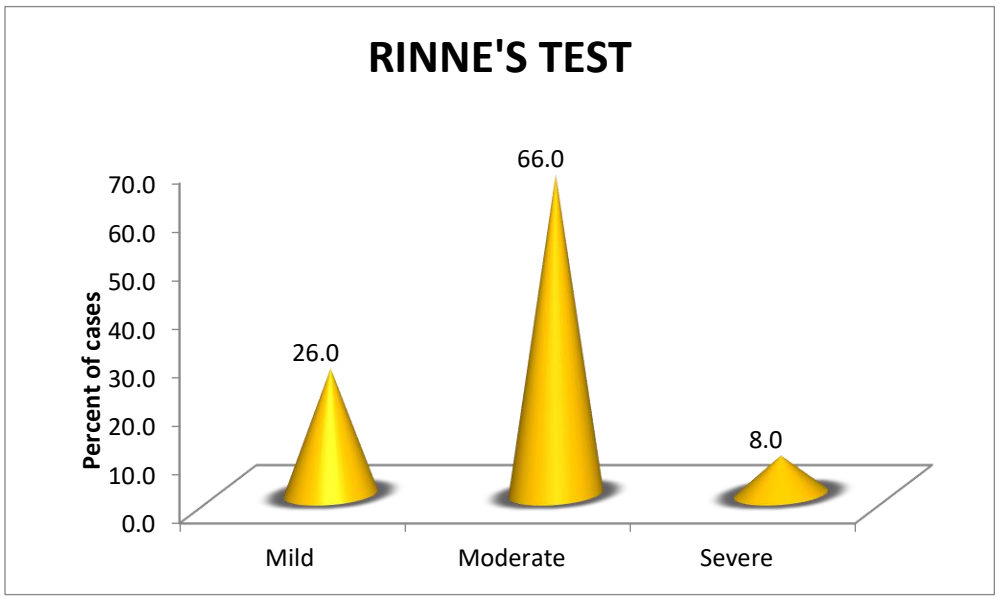

Graph 2 –Bar diagram showing Rinne's test findings in all cases of COM

In our study rinne's test reveled moderate conductive hearing loss in 33(66%)patients, mild in 13(26%)patients, and severe in 4 (8%) patients.

Table 3 – Table showing Weber's test findings in all cases of COM

WEBER'S TEST	No of Cases	Percentage
Lateralised to Right	17	34
Lateralised to Left	33	66
Total	50	100

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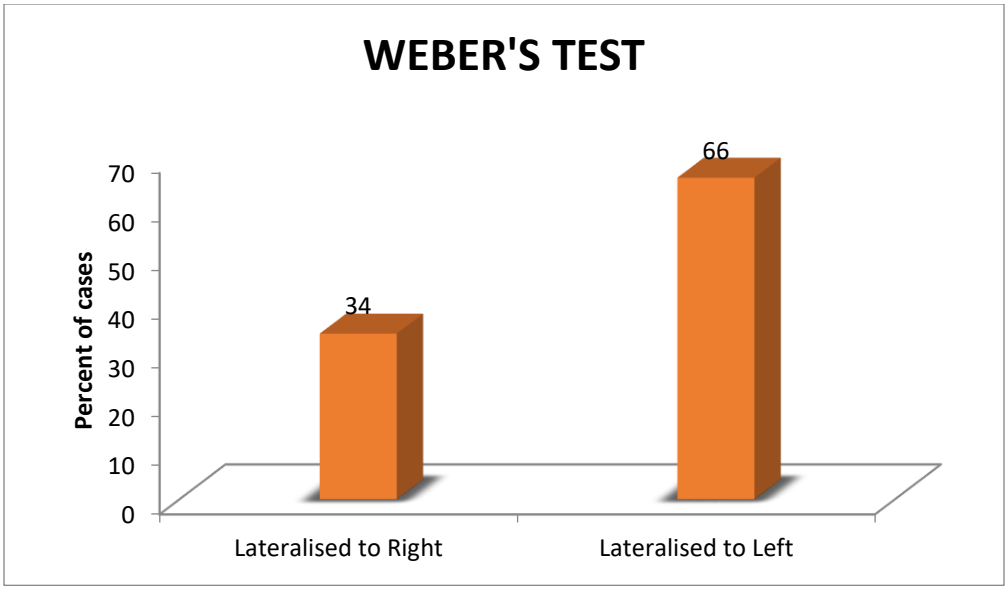

Graph 3 – Bar diagram showing Weber's test findings in all cases of COM

In our study webers is found to be lateralized to right in 17 (34%)patients, lateralized to left in 33(66%)patients.

Table 4 – Table showing Absolute bone conduction test findings in all cases of COM

ABSOLUTE BONE CONDUCTION TEST	No of Cases	Percentage
Same	50	100
Reduced	0	0
Total	50	100

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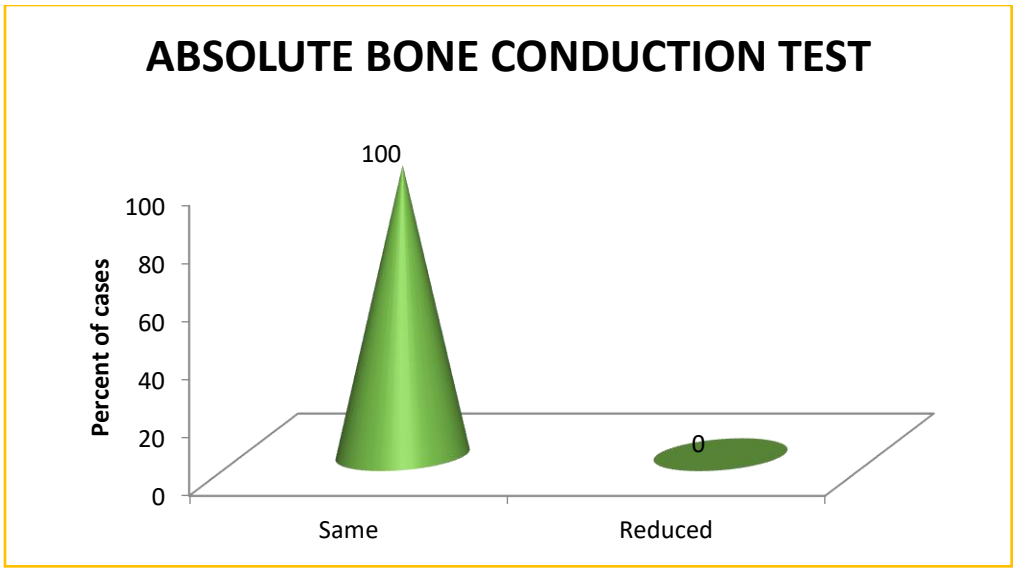

Graph 4– Graph showing Absolute bone conduction test findings in all cases of COM

In our study absolute bone conduction test showed same as examiner in 50 (100%) patients.

Table 5–Table showing PTA standard deviation in COM patients

PTA	
Mean	36.57
Std. Deviation	10.73
Minimum	18.30
Maximum	60.00

In our study , PTA results were found to be standard deviation of 10.73 , minimum 18.30 , and maximum is 60.

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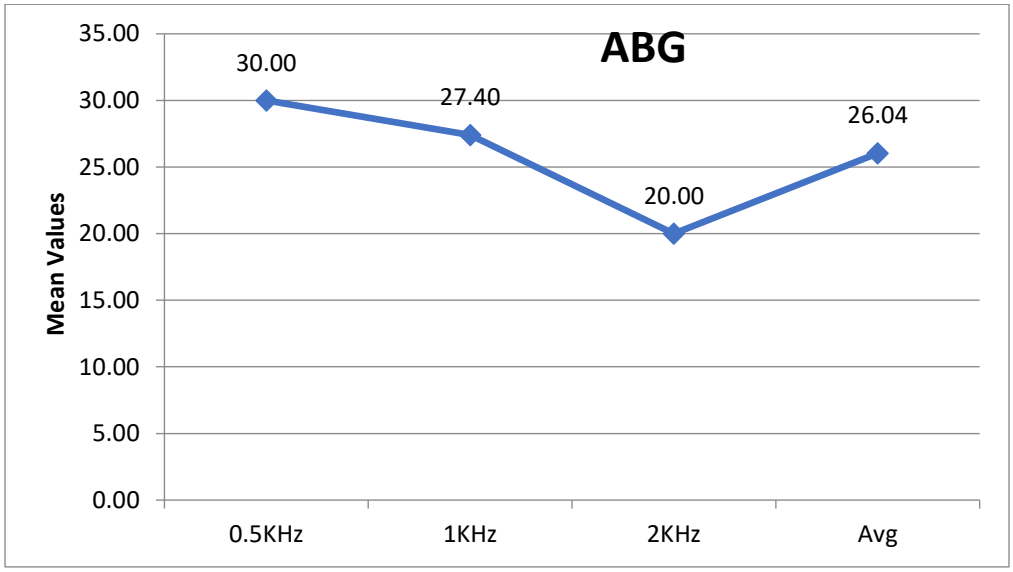
Table 6 –table showing ABG standard deviation in COM patients

ABG	Mean	Std. Deviation	Minimum	Maximum
0.5KHz	30.00	10.83	10.00	55.00
1KHz	27.40	10.70	10.00	50.00
2KHz	20.00	13.01	0.00	50.00
Avg	26.04	9.87	10.00	46.60



Graph 5– Line diagram showing ABG standard deviation in COM patients

In our study the ABG results are, standard deviation is 9.87, minimum is 10, and maximum is 46.60 , and mean is 26.04.

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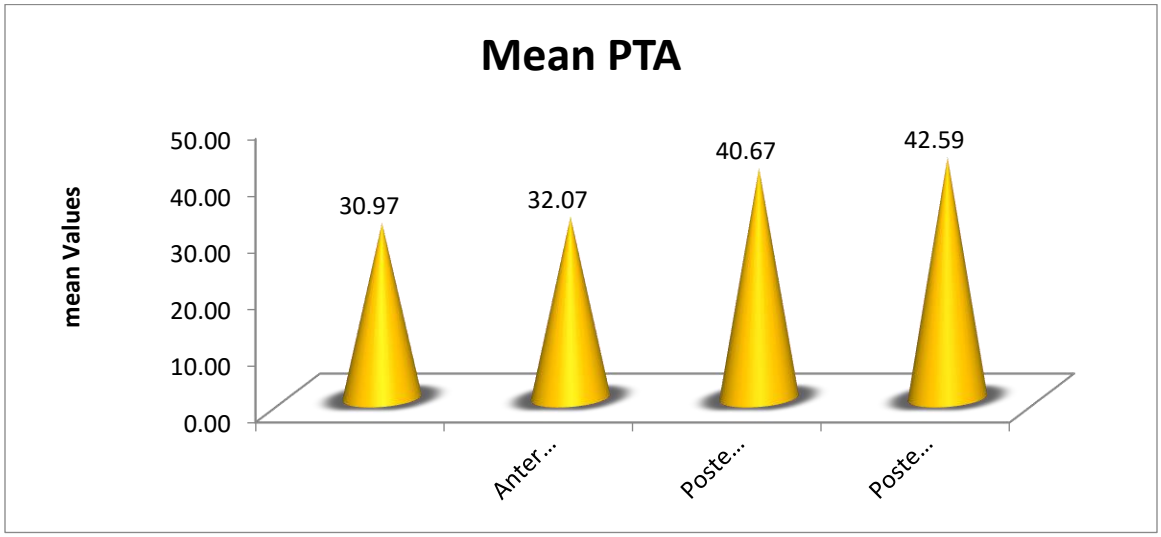
Table 7 –Table showing association of pars tensa site of perforation with PTA

PARS TENSA PERFORATION	No	PTA		ANOVA	
		Mean	Std. Deviation	P Value	Sig
Anterosuperior	11	30.97	10.17	0.01	Sig
Anteroinferior	13	32.07	11.03		
Posterosuperior	19	40.67	8.20		
Posteroinferior	7	42.59	11.22		



Graph 6– Graph showing association of Pars tensa site of perforation with PTA

In our study majority of study subjects has posterosuperior perforation with greater PTA loss of mean 40.67, standard deviation of 8.2 with p value 0.001 that is highly significant. Next is anteroinferior with PTA loss of mean 32.07 , standard deviation of 11.03 with p value 0.001 that

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is highly significant. Next is anterosuperior perforation with PTA loss of 30.97 , standard deviation of 10.17 with p value 0.001 that is highly significant. Next is posteroinferior with PTA loss of mean 42.59 , standard deviation of 11.22 with p value 0.001 that is highly significant.

DISCUSSION

COM (Tympanic membrane perforation)is a very common disorder caused either by infection or trauma, resulting in decreased hearing. So, a meticulous examination, diagnosis and treatment of tympanic membrane perforation are necessary for the assessment and restoration of hearing loss.

We observed in our study that hearing loss was more in posterior perforation, followed by anterior perforations. This view has been supported by Bianca et al [11] and Malik et al [12] in their studies. They attributed this effect to the direct exposure of the round window to the sound waves resulting in cancellation of the phase difference between the two windows and resultant nonmovement of perilymph.[11,12] However Pannu et al[13]and Kumar et al[14,]differed from this view in their study and suggested that location of perforation does not affect the degree of hearing loss.[14]

Hearing loss in relation with the site of the perforation:

In our study majority of study subjects has posterosuperior perforation with greater PTA loss of mean 40.67, standard deviation of 8.2 with p value 0.001 that is highly significant. Next is anteroinferior with PTA loss of mean 32.07 ,standard deviation of 11.03 with p value 0.001 that is highly significant. Next is anterosuperior perforation with PTA loss of 30.97 , standard deviation of 10.17 with p value 0.001 that is highly significant. Next is posteroinferior with PTA loss of mean 42.59 , standard deviation of 11.22 with p value 0.001 that is highly significant.

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Those perforations with posterior quadrant involvement had a higher hearing loss. This could be due to the direct exposure of the round window in the posterior perforations as shown in other studies. This results in loss of the phase differential necessary for one to have perilymph movement.[9-12]

Bhusal et al noted that large perforations with 4 quadrant involvements had a hearing loss of 49dbHL and those in the anterior quadrants had hearing loss of at least 31dBHL.[8]

Ahmed also noted a greater hearing loss in posterior based perfroations. He noted a hearing loss of 29db and in anterior perforations noted a hearing loss of 18.5.[9] Mahajan noted that the posterior based perforations ($p=<0.05$) had significant hearing loss.[4] Nepal et al in his 100 cases noted that perforations involving posterior inferior quadrant had a hearing loss of 41-53dB.[5] Durko in the 145 cases he reviewed hearing loss in the posteroinferior quadrants was up to 30dbHL while rest had an average of 20dBHL.[15]

This is in agreement with the earlier observations by Ahmad and Ramani.[16] It also conforms to the historic findings of Bekesy[16] Payne and Gither [17] that the position of the TM perforations affects the magnitude of hearing loss.[15-17] However the effect of direct impaction of sound energy into the middle ear leading to the loss of "round window baffle", as they suggested; may not be the only reason bearing in mind ,the complex mode of sound transmission across the middle ear as shown by recent models on sound-energy transmission through TM into the middle ear. [15-18]

Table 9: Summary of studies showing Site of perforation and degree of hearing loss.

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Author	Site of perforation.	Degree of hearing loss (dBHL).
Bhusal et al	large perforations(4 quadrant involvement.	49dBHL
	Anterior quadrant perforation.	31dBHL
Yung et al	Big central/posterior central perforations.	43dBHL
Ahmad and ramani	Posterior perforations.	29dBHL
	Anterior perforations.	18.5dBHL
Nepal et al.	Posterior perforations	41-53dBHL
Durko et al.	posteroinferior quadrants	30dBHL
	anterior qua.	20dBHL
In our study	Posteriosuperior Posterioinferior Anterisuperior anterioinferior	40.67dBHL 42.59dBHL 30.97dBHL 32.07dBHL

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CONCLUSION

Tympanic membrane perforations due to chronic otitis media are common in our setup and these could be attributed to risk factors such as low socioeconomic status which result in poor hygiene, overcrowding.

Overall this study has shown significant correlation between the site and the degree of hearing loss Hearing loss depends on the site of tympanic membrane perforation. Hearing loss is more in posterior perforation of tympanic membrane than in anterior perforation. As loss is more than 40dB, there is chance of involvement of ossicles. This preoperative knowledge can influence the surgical decision making and also help the surgeon be prepared for reconstruction of the hearing mechanism or ossiculoplasty.

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