



ORIGINAL RESEARCH PAPER

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ASSESSMENT OF HEARING LOSS IN RELATION TO SITE AND SIZE OF TYMPANIC MEMBRANE PERFORATION

KEY WORDS: Hearing loss, site and size of perforation.

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ABSTRACT

This retrospective study was undertaken over 100 patients to assess the hearing loss with size and site of tympanic membrane perforation. Tympanic membrane(TM) perforation leads to chronic discharging ear and hearing loss. The site of perforation in the tympanic membrane and the duration of ear discharge have significant effect on the magnitude of hearing loss. For instance, posterior quadrant perforations are having poorer hearing than the anterior ones, if there is direct exposure of the round window to sound. Persistent ear discharge is also supposed to deteriorate hearing level with passage of time.

INTRODUCTION

Chronic suppurative otitis media is a long standing infection of a part or whole of the middle ear cleft characterized by ear discharge and a permanent perforation and hearing loss¹. A perforation becomes permanent when its edges are covered by squamous epithelium and it does not heal spontaneously.

Perforations of the tympanic membrane are described according to their anatomical location. Central perforations are in the pars tensa and are surrounded by some residual tympanic membrane or at least the annulus all around. The pars tensa (central) perforations can be better assessed and are morphologically classified arbitrarily by the demarcation with the vertical line passing through the long axis of handle of malleus and the horizontal line passing perpendicularly to the first line through umbo into: (a) Anterosuperior (b) Anteroinferior (c) Postero-superior (d) Posteroinferior². Similarly a perforation qualifies as small, medium and large based on their sizes. Small central perforation is less than size of a single quadrant. Medium size perforation involves two quadrants. Large central perforation involves more than two quadrants. Subtotal perforation involves all quadrants and surrounded by a completely intact annulus.³

Clinically the effects of tympanic membrane perforations vary greatly depending upon the size, location of perforation and presence or absence of middle ear pathology.⁴ Central perforations of the tympanic membrane with an intact ossicular chain has a hearing loss of approximately 10-30dB.⁵

A perforation in the tympanic membrane reduces the effective area of membrane in contact with the sound wave. Perforations also reduce the pressure differential across the tympanic membrane and depending on their position, reduce the mechanical coupling between the remaining intact portions of the membrane and the malleus.

It is acknowledged fact that size and site of tympanic membrane perforation is proportionate to degree of hearing loss⁶, larger the perforation, greater the hearing loss⁷. However, some workers believe that there is no significant effect associated with location of the perforation.⁸

There is a significant quantitative correlation between the size and site of perforation and hearing loss. Small perforations (10% of the membrane) produce losses of 10-15 dB below 3 KHz. Large perforations produce severe losses over the whole range particularly at higher frequencies, through these perforations, the sound waves act directly on the round & oval windows. Small and moderate perforations (10-40% of the area) have far more severe effects when placed on the posterior and superior part of the membrane.

Small anterior defects often produce no deafness.⁹ Perforation in the posterior quadrant, when directly exposes the round window niche, the "round window baffle" effect is lost causing a greater hearing loss than expected for the size of the perforation.¹⁰ Clinically the effects of tympanic membrane perforations vary greatly depending upon the size, location of perforation and presence or absence of middle ear pathology.^{11,12}

MATERIALS AND METHODS

This is a retrospective study carried out over a period of 6 month (Oct 2018 to March 2019) at FH Medical College, Agra. 100 cases of chronic otitis media (mucosal, inactive type having central perforation with conductive deafness) were selected for the study. All patients were subjected to detailed examination as under:-

1. History and detailed ENT, Head & Neck examination.
2. Examination under microscope to assess the status of the ossicular chain and to rule out the Cholesteatoma.
3. Tuning fork tests were done in every case and hearing levels were assessed with calibrated audiometer (Elkon) at frequencies 250 KHz, 500 KHz, 1000 KHz, 2000 KHz, 4000 KHz and 8000 KHz respectively in acoustically treated sound proof room by an experienced audiologist. Air and bone conduction thresholds were documented. Average hearing loss was calculated through the pure tone average taken at 500Hz, 1000 Hz, and 2000 Hz.
4. **Methodology to measure the size of perforation-** In our study, to measure the size of perforation, we have used thin transparency sheet, on which a graph paper of 1x1 square mm size was printed.¹³ This transparency sheet was pre-sterilized in cidx.

RESULTS-

(1) Size of perforation

Size of perforation in square mms	No. of ears	Average area of TM involved by perforation
1-14	42	7.46
15-27	39	19.59
28-41	2	38
42-55	17	48.06
Total	100	

On ascertaining the size of tympanic membrane perforation, it was observed that out of 100 ears, 42 (average size 7.46 square mms) were having small TM perforation, 39 (average size 19.59 square mms) were having moderate TM perforation, 2 (average size 38 square mms) were having large TM perforation and 17 (average size 48.06 square mms) were having subtotal TM perforation.

(2) Hearing loss in respect to size of perforation

Size of perforation in square mms	No. of ears	Average of TM involved by perforation	Pure tone Average (dB)	Air bone gap (dB)
1-14	42	7.46	34.26	22.33
15-27	39	19.59	44	30.54
28-41	2	38	45.50	36.50
42-55	17	48.06	49.31	35.87
Total	100			

Pre-operative audiometric pattern of 100 patients in relation to size of perforation were studied and pure tone average along with air bone gap was calculated. It was observed that maximum pure tone average loss (49.31 dB) was found in

perforations in between (42-55 sq mm), and maximum air bone gap (36.50 dB) was found in perforations in between (28-41 sq mm).

(3) Hearing loss according to Site of tympanic membrane perforation

Quadrants involvement	Site of perforation according to quadrant	No. of ears	Percentage (%)	Pure tone Average (dB)	Air bone gap (dB)
Single quadrant	AI	23	23	30.36	18.90
	PI	18	18	39.10	24.68
	AS	1	1	25	12
	PS	0	0	0	0
Two quadrant	AS + AI	7	7	37.12	24
	PS + PI	18	18	46.83	32.94
	AI + PI	14	14	42.15	28.84
Three quadrant	AS + AI + PI	0	0	0	0
	PS + PI + AI	1	1	46	33
Four quadrant	AS + AI + PS + PI	18	18	48.88	35.94
Total		100	100		

Pre-operative audiometric pattern of 100 patients in relation to site of perforation were noted and pure tone average along with air bone gap was studied. It was observed that maximum pure tone average (48.88 dB) and air bone gap (35.94 dB) was noted in the perforations involving all the four quadrants (AS + AI + PS + PI).

DISCUSSION-

It is acknowledged that size and site of tympanic membrane perforation is proportional to degree of hearing loss but there are some studies, which suggests otherwise.⁶

Main cause of conductive hearing loss is tympanic membrane perforation in cases of CSOM and not any other middle ear pathology, as Sakagami M et al observed that chronic suppurative otitis media as main cause of hearing loss, in which 82 out of 91 cases with chronic suppurative otitis media had a tympanic membrane perforation with intact ossicular chain. So, this study was under taken to find out the correlation between size and site of perforation with hearing loss.¹⁴

In our study, perforation size in between 1 to 14 square mm (small) had shown average hearing loss of 34.26 dB. Study conducted by Nishant Kumar et al¹³ had shown average hearing loss of 28.23 dB in 1 to 14 square mm size perforation.

In our study, perforation size in between 15 to 27 square mm (medium) had shown average hearing loss of 44 dB. Nishant Kumar et al had shown average hearing loss of 32.42 dB in 15 to 27 square mm perforations.

In our study, perforation size in between 28 to 41 square mm (large) had shown average hearing loss of 45.50 dB. Nishant Kumar et al had shown average hearing loss of 36.26 dB in 28 to 41 square mm size perforations.

In our study, subtotal perforation measuring size (42 to 55 square mm) had 49.31 dB average hearing loss, while this was 44.62 dB, in same sizes of perforation in the study of Nishant Kumar et al.

The single quadrant anteroinferior (AI) perforations, whose average hearing loss was 30.36 dB in our study, while this was

26.6 dB in study of Nishant Kumar et al. A Nepal et al⁷ had reported 50% of anteroinferior (AI) quadrant perforations with mild, 29% with moderate & 21% with minimal hearing loss.

Posteroinferior (PI) quadrant perforations had 39.10 dB average hearing loss in our study, while it was 32.4 dB in study of Nishant Kumar et al and in study of A Nepal et al, 50% of these perforations had mild, 39% moderate & 11% had minimal hearing loss.

In single quadrant anterosuperior (AS) perforation, in our study had hearing loss of 25 dB, while In the study of A Nepal et al, 50% of these perforations had moderate, 25% had mild and 25% had minimal hearing loss.

Two quadrants perforations (anterosuperior + anteroinferior = AS + AI) in our study had shown 37.12 dB average hearing loss, which was 28.6 dB average hearing loss in study of Nishant Kumar et al.

The posterosuperior & posteroinferior (PS+PI) perforations had shown 46.83 dB average hearing loss in our study, which was 36.6 dB in study of Nishant Kumar et al.

In anteroinferior & posteroinferior (AI + PI) in our study had shown 42.15 dB average hearing loss, while Nishant Kumar et al noted 32 dB average hearing loss.

Three quadrants perforation, posterosuperior, posteroinferior & anteroinferior (PS+PI+AI) had 46 dB hearing loss. Nishant Kumar et al showed average hearing loss of 36.6 dB.

All four quadrants perforations (PS+PI+AS+AI) in our study had shown 48.88 dB average hearing loss, which was 44.6 dB average hearing loss in study of Nishant Kumar et al. A Nepal et al had noted that 12 cases of all quadrant perforations had moderate hearing loss, while 2 of these had mild hearing loss.

CONCLUSION-

In our study, we observed significant relationship between size and site of tympanic membrane perforation with hearing loss, larger the size of perforation, more was average hearing

loss and found same relation with site i.e. perforation involving all four quadrants were having more average hearing loss. There is definite difference in anterior and posterior perforations; more hearing loss was noted in posterior perforation. Our study will help ENT surgeons in assessing hearing loss on the basis of site and size of perforation.

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