# **Original Research Article**

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# Hearing assessment in patients with tympanosclerosis with intact tympanic membrane

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#### **ABSTRACT**

**Background:** Tympanosclerosis is an irreversible, though not immutable, end result of any unresolved specific or nonspecific inflammatory disease of middle ear characterized by anatomical distortion resulting in functional impairment. The objective of the study was to assess hearing in patients with tympanosclerosis with intact tympanic membrane (TM) and to correlate degree of hearing loss with respect to site of tympanosclerotic patch on TM.

Methods: This cross-sectional study was conducted at Bangalore Medical College and Research Institute, Bangalore during study period from November 2016 to May 2018. Thirty patients enrolled for study were subjected to otoendoscopy, pure tone audiometry and tympanometry. Site of tympanosclerotic patch on tympanic membrane and hearing loss were assessed and correlated statistically.

**Results:** Thirty patients (13-males, 17-females), aged 6–73 years (average-39.5 years) who fulfilled inclusion criteria were included. 7 (23.3%) patients had bilaterally affected ears amounting to 37 tympanosclerotic ears. left ear was commonly affected 14 (46.6%). In most patients, tympanosclerosis of tympanic membrane was an incidental finding with patients being otologically asymptomatic. The locations of tympanosclerotic patch on TM were 9 (24.4%) postero-superior, 7 (18.9%) postero-superior and postero-inferior, 7 (18.9%) antero-inferior, 5 (13.5%) posteroinferior, 3 (8.1%) antero-superior, 3 (8.1%) antero-superior and antero-inferior, 2 (5.4%) antero-inferior and posteroinferior and 1 (2.7%) entire pars tensa. Hearing level ranged from 10-46.6 dBHL (normal to moderate) with majority (91.89%) of patients had hearing within 25 dBHL. 43.3% had conductive hearing loss, 2.7% had sensorineural hearing loss and rest had normal hearing. Correlation of site of tympanosclerotic patch on TM with degree of hearing loss was not statistically significant (p=0.058).

**Conclusions:** Variations in the site of tympanosclerotic patch on TM do not affect degree of hearing loss.

**Keywords:** Tympanosclerosis, Intact tympanic membrane, Hearing loss, Pure tone audiometry, Tympanometry

#### INTRODUCTION

Tympanosclerosis is an irreversible, though not immutable, end result of any unresolved specific or nonspecific inflammatory disease of the middle ear characterized by anatomical distortion resulting in functional impairment.1

The etiology is not clearly known. Many hypotheses have been proposed like sequelae of acute or chronic otitis media, stagnation of secretions in the mucosal folds, immunologic mechanism, disordered fibrogenesis during healing following long standing inflammation and so on.<sup>2</sup> Typically ears of tympanosclerosis are free of active suppuration.<sup>3</sup> Histopathological tympanosclerotic plaques reveal dense fibrous and collagenous connective tissue, with hyaline degeneration and later calcification in the tympanic mucosa.<sup>4</sup>

The term 'myringosclerosis' is used when only the tympanic membrane is involved.<sup>5</sup> Myringosclerotic lesions are seen as whitish, sclerotic plaques in the tympanic membrane.<sup>6</sup> Myringosclerosis may assume clinical importance by interfering with the transmission of sound vibrations across the middle ear leading to conductive hearing loss.<sup>7</sup>

Studies of tympanosclerosis available in literature, are on association of hearing loss in patients with tympanosclerosis in the presence of chronic suppurative otitis media (CSOM) with perforated tympanic membrane (TM). CSOM with perforated TM contributes to hearing loss independently. These studies do not describe the degree of hearing loss with respect to site of tympanosclerotic patch on tympanic membrane. Extensive literature search showed only one article, and hence the need for this study.

## **Objectives**

The objectives of the study were to assess hearing in patients with tympanosclerosis with intact tympanic membrane; to correlate the degree of hearing loss with respect to site of tympanosclerotic patch on tympanic membrane.

#### **METHODS**

This cross-sectional study included thirty patients with 37 tympanosclerotic ears with intact TM. Patients attending to ENT outpatient department at Bangalore medical college and research institute, Bangalore during period November 2016 to May 2018 were enrolled for the study after the ethical committee clearance.

#### Inclusion criteria

Patients willing to give written and informed consent and patients with tympanosclerosis with intact tympanic membrane irrespective of age and sex were included in this study.

#### Exclusion criteria

Patients with chronic suppurative otitis media and patients with H/O previous ear surgeries were excluded.

Detailed clinical history was taken regarding the deafness, ear discharge, recurrent attacks of cold and allergy and any history of previous surgeries. A thorough ENT examination of patients was done. Examination of ears was done with otoscope and the appearance of tympanic membrane with site of tympanosclerotic patch on tympanic membrane noted. Clinical assessment of hearing was done by the tuning fork tests. Otoendoscopy was done to visualize the condition of tympanic

membrane, tympanosclerotic plaques in the tympanic membrane and to confirm the otoscopic findings.

Pure tone audiometry and tympanometry were done for all patients. By pure tone audiometry, patients' hearing level in decibel was assessed at frequencies 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz. Air and bone conduction thresholds were determined at these frequencies. Pure tone average was calculated for hearing thresholds at frequencies 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz to know magnitude of hearing loss. Assessment of hearing was done in terms of magnitude, degree and type of hearing loss. Then, correlation was made between degree of hearing loss and site of tympanosclerotic patch on tympanic membrane.

The data has been statistically analyzed by software SPSS statistics 24.0 and presented in the form of tables, figures, graphs, diagrams wherever necessary. Kruskal-Wallis H test or one-way ANOVA on ranks test has been used to correlate degree of hearing loss and site of tympanosclerotic patch on tympanic membrane.

#### **RESULTS**

Thirty patients of tympanosclerosis with intact tympanic membrane were enrolled for this study irrespective of age and sex. The study population showed female preponderance with 17 (57%) females and 13 (43%) males (Table 1). Most common age group was between 21-30 years (30%) (Figure 1).

**Table 1: Gender distribution of patients.** 

S. no.	Gender	Frequency (n=30)	Percentage (%)	
1.	Male	13	43.33	
2.	Female	17	57.77	

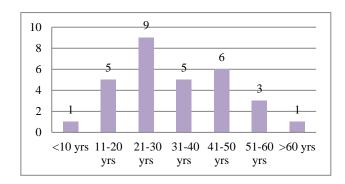


Figure 1: Distribution of patients according to age group.

Out of 30 patients, 17 (56.6%) had complaints in contralateral ear, 9 (30%) had complaints in tympanosclerotic ear, 3(10%) had complaints in nose and throat and 1(3.3%) had parotitis (Figure 2). The right ear was affected in 9 patients, left ear was affected in 14 patients and bilateral ears were affected in 7 patients. So,

total number of ears in study were 37. Most common site of tympanosclerotic patch on tympanic membrane was postero-superior quadrant of pars tensa. Pars flaccida was spared in all ears (Figure 3). Out of 37 tympanosclerotic ears, 28 (75.6%) had 'A' type of tympanometric curve, 5 (13.5%) had 'As' type and 4 (10.9%) had 'B' type.

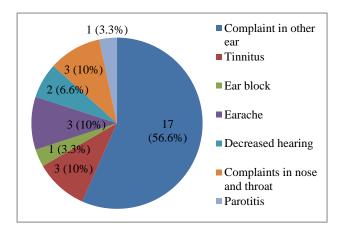


Figure 2: Distribution of patients according to their chief complaints.

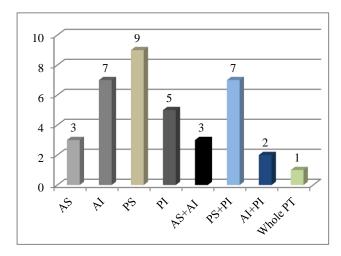


Figure 3: Distribution of ears according to site of TS patch on TM.

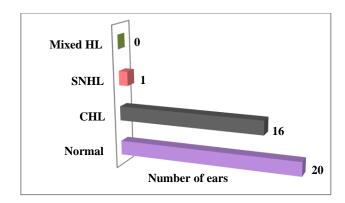


Figure 4: Distribution of ears according to type of hearing loss.

Out of 37 ears, 16 had normal hearing, 18 had slight hearing loss, 2 had mild hearing loss and 1 had moderate hearing loss (Table 2). Common type of hearing loss was conductive type (Figure 4) with only one patient showing SNHL.

Table 2: Distribution of ears according to degree of hearing loss.

S. no.	Degree of hearing loss	Hearing loss range (in dB HL)	No of ears (n=37)	%
1.	Normal	0.0-15.0	16	43.2
2.	Slight	15.1-25.0	18	48.6
3.	Mild	25.1-40.0	2	5.4
4.	Moderate	40.1-55.0	1	2.7

In tympanosclerotic ears with intact TM, mean hearing loss was maximum for anterior half involvement of tympanic membrane by TS patch. Hearing loss was 46.6 dB in ear with entire pars tensa involved by tympanosclerotic patch. The correlation between degree of hearing loss and site of tympanosclerotic patch on tympanic membrane was not statistically significant as p>0.05.

Table 3: Correlation between degree of hearing loss and site of TS patch on TM.

		Degree of hearing loss				
		Normal hearing loss	Slight hearing loss	Mild hearing loss	Moderate hearing loss	Total
Site of TS	Antero-superior	2	1	0	0	3
	Antero-inferior	5	2	0	0	7
	Antero-superior+ antero-inferior	0	2	1	0	3
patch	Postero-superior	2	6	1	0	9
on TM	Postero-inferior	4	1	0	0	5
	Postero-superior +postero-inferior	2	5	0	0	7
	Antero-inferior+ postero-inferior	1	1	0	0	2
	Entire pars tensa	0	0	0	0	1
Total		16	18	2	1	37



Figure 5: Otoendoscopic image of left TM with TS patch involving antero-superior+antero-inferior quadrants.

#### **DISCUSSION**

Tympanosclerosis often remains clinically silent until hearing loss appears. Hearing loss is usually of conductive type, degree of hearing loss depends on extent and location of tympanosclerotic plaques in tympanic membrane and middle ear cavity. Hearing loss due to tympanosclerosis of the tympanic membrane can either be absent or negligible, or it can reach up to 40 dBHL. 14 When large areas of the tympanic membrane are involved, however, mobility of the membrane may be impaired which will result in a mild to moderate hearing loss. Mobility of the membrane may be severely reduced if the plaque is adherent to the bony annulus or the handle of the malleus or makes contact with the promontory.

In our series, a slight female preponderance was noted with 17 (57%) females and 13 (43%) males. The male to female ratio was 2:3 which is in correlation with studies by Gibb et al, Dubreuil et al, Lacher et al, Tos et al and Emmett et al.<sup>7,13-16</sup>

On analyzing the age distribution of patients, it was observed that average age of the patients was 39.5 years. The youngest patient was of age 6 years and oldest patient was in 73 years old. Tympanosclerosis of the tympanic membrane can occur at any age. In literature, tympanosclerosis has been reported in a child as young as 2 years. 17

Majority of patients in our series belonged to age group between 21-30 years (30%) followed by 41-50 years age group (20%). This is in consistence with studies conducted by Pal et al and Rao et al.<sup>2,18</sup>

In our study, we found that majority (70%) of the patients had no complaints in the tympanosclerotic ear. These patients had come to the OPD for their complaints in the contralateral ear (56.6%), complaints in nose and throat (10%) and parotitis (3.3%), and the tympanosclerosis with an intact TM was just an incidental finding. Tympanic membrane tympanosclerosis is asymptomatic in most instances.<sup>8</sup>

Out of the 37 tympanosclerotic ears studied, right ear was affected in 9 patients, left ear was affected in 14 patients. The incidence of bilateral disease was 23.33%. In literature, incidence of bilateral tympanosclerosis has been reported to be around 40-60%. <sup>13,14</sup>

The postero-superior quadrant of pars tensa of the tympanic membrane was most commonly involved by tympanosclerosis in our series while pars flaccida was not involved in any of the patients.

Different studies have stated different findings with respect to site of involvement of the TM by tympanosclerosis. Bhaya et al reported the anterior and postero-inferior quadrants to be the most frequently involved, according to Yabe et al, it were the antero-superior and postero-superior quadrants, according to Jaisinghani, it was the antero-inferior quadrant and according to Pal et al and Rao et al, it was postero-superior quadrant of the pars tensa. Phowever the pars flaccida was always spared according to all studies. The lack of unanimity of opinion regarding the commonest quadrant of involvement probably suggests that tympanosclerosis actually does not have any predilection for any particular site on tympanic membrane.

Most common type of tympanogram tracing in tympanosclerotic ears with intact tympanic membrane was 'A' type in our series. Gibb reported that commonest type of tympanometric curve in patients with tympanosclerosis was the 'As' type indicating stiffness of the sound conducting mechanism.<sup>7</sup> Pal reported that 63.3% ears with tympanic membrane tympanosclerosis showed a type 'B' curve.<sup>2</sup> The As and B type of tympanogram seen in our patients may be due to the presence of concomitant middle ear tympanosclerosis involving the ossicular chain. Such cases may require further evaluation by exploratory tympanotomy or a high resolution computed tomography scan of the temporal bone.

Hearing in tympanosclerotic ears varied from normal to moderate hearing loss in our study. This is in consonance with other studies by Gibb et al, Asiri et al, Kaur et al and Stankovic et al. 7,9-11 Hearing loss of 46.6 dB was seen in one patient, in whom the entire pars tensa was involved by tympanosclerotic patch.

In our series, majority of the patients (91%) had normal hearing within 25 dBHL and only 3 patients had mild to

moderate hearing loss. The mild to moderate hearing loss could be due to severely impaired mobility of the tympanic membrane by tympanosclerotic plaque due to adherence to bony annulus or to the handle of malleus, plaque in contact with the promontory or presence of concomitant middle ear tympanosclerosis requiring further evaluation.

In our series, conductive type of hearing loss was present in 16 (43%) tympanosclerotic ears with intact tympanic membrane, one (3%) had sensorineural hearing loss and rest had normal hearing (54%). So, patients with clinically significant hearing loss had predominantly conductive type of hearing loss. This is in accordance with other studies. 8,24,25 Sensorineural type of hearing loss observed in one patient in our series could be due to age related hearing loss as the patient was 73 years of age. However, Gibb et al suggested sensorineural hearing loss could be due to the previous episodes of active middle ear inflammation or due to the involvement of the inner ear by tympanosclerosis. 7

In our series, mean hearing loss was maximum for those ears with anterior half involvement of the TM by tympanosclerotic plaque which is in contrast with the study by Munish who found hearing loss to be maximum when postero-superior quadrant was involved by tympanosclerotic plaque.<sup>22</sup>

The correlation between degree of hearing loss and site of tympanosclerotic patch on tympanic membrane was not statistically significant. So, variations in the site of tympanosclerotic patch on the TM do not affect the degree of hearing loss. In a similar study conducted by Munish et al, the degree of hearing loss was more in the patients having tympanosclerotic patch in the posterosuperior quadrant. However the statistical significance of this finding was not assessed.<sup>22</sup>

## **CONCLUSION**

In otologically asymptomatic patients, tympanosclerosis is an incidental finding often associated with heaing loss within 25 dBHL. In patients with higher degree of hearing loss with tympanosclerosis and intact tympanic membrane may require exploratory tympanotomy for assessment of middle ear tympanosclerosis is suggested. Variations in the site of tympanosclerotic patch on the TM do not affect the degree of hearing loss.

Myringosclerotic plaque can be left undisturbed during tympanoplasty unless tympanic membrane perforation edges are involved by myringosclerotic plaque as tympanosclerosis limited to tympanic membrane causes no significant hearing loss and can thus be ignored.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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