International Journal of Research in Medical Sciences
*Reddy Gangyada PK et al. Int J Res Med Sci. 2023 Nov;11(11):4160-4164*
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20233392

**Original Research Article**

# Prevalence of otosclerosis among patients having deafness with intact tympanic membrane: a hospital based cross-sectional study

**Pavan Kalyan Reddy Gangyada*, Sanjay Kishve**

[1]Department of Otorhinolaryngology, Employees State Insurance Corporation Medical College, Hyderabad, Telangana, India

**Received:** 24 September 2023
**Revised:** 16 October 2023
**Accepted:** 19 October 2023

***Correspondence:**
Dr. Pavan Kalyan Reddy Gangyada,
E-mail: gpkalyanreddy@gmail.com



## ABSTRACT

**Background:** Otosclerosis is a progressive and primary metabolic bone disease that results from abnormal bone remodeling of the otic capsule. Present study was undertaken to find out the prevalence of otosclerosis among patients having deafness with intact tympanic membrane. Aim was to find out association of otosclerosis with gender, correlation with age. To find out the type and degree of hearing loss.
**Methods:** A total of 206 patients belonging to age group of 10-60 years fitting in the inclusion criteria were investigated for the presence of otosclerosis using Otoscopy, Pure Tone Audiometry, Tympanometry, HRCT temporal bone.
**Results:** The prevalence of otosclerosis among our study population was 9.2% (3.9% were males and 5.3% were females). Association of otosclerosis with gender and correlation of otosclerosis with age was not significant.
**Conclusions:** Our study showed presence of otosclerosis in 9.2%. Otosclerosis is not associated with age. Degree of hearing loss in patients diagnosed with otosclerosis was in between 30 to 50 dB and 89.4% of them had conductive deafness, 10.6% had mixed deafness.

**Keywords:** Carhart's notch, Otosclerosis, Schwartz sign, Tympanometry

## INTRODUCTION

Otosclerosis is a progressive and primary metabolic bone disease that results from abnormal bone remodeling of the otic capsule which typically manifests in early adulthood. Initially otosclerosis presents with resorption of bone and replacement with highly vascularized spongy bone. Then there will be fixation of the anterior stapes footplate, which progresses to fixation of entire foot plate.[1] It is considered as a complex disease with both genetic and environmental factors, otosclerosis can occur in isolated cases with no family history (non-familial) and positive family history of otosclerosis has been previously reported in between 30-70% of cases. The pattern of inheritance in familial otosclerosis is autosomal dominant pattern.[2] Otosclerosis is categorized into two types, fenestral and retro fenestral (cochlear).[3] Retro Fenestral otosclerosis occurs mostly along with the fenestral involvement so these manifestations are a continuum rather than two separate entities.[4] Otosclerosis is the most common cause of deafness among Caucasians, uncommon in Blacks, Asians and Native Americans.[5] It usually presents as a bilateral disease affecting both the ears, most commonly in women.[6] The main clinical manifestation in patients with otosclerosis is progressive hearing loss, tinnitus and dizziness. If the lesion invades the stapedial annular ligament, causing the fixation of stapes foot plate then conductive hearing loss will occur. If the lesion invades the cochlear region, then sensorineural hearing loss will occur.[7] Causes of otosclerosis are most likely due to autoimmunity, cytokines of bone metabolism, measles infection,

hormones and environmental influence.[8] Histological examinations have shown that otosclerosis is characterized by focal changes in the bony labyrinth that occur in four stages.

States are fallows: Stage I: Inflammatory resorption of woven bone of the otic capsule by osteoclasts, Stage II: Replacement by spongy vascular bone (otospongiotic phase), Stage III: Osteoclastic degradation of the spongy bone, replacement by compact lamellar bone (otosclerotic phase), Stage IV: Suspension of remodeling processes, in which active resorption and recalcification frequently coexist.[9]

There is no causal therapy for otosclerosis. Third generation bisphosphonates are used to prevent the progression of otosclerosis.[10] Standard treatment of the otosclerosis is surgical treatment by stapedotomy. In this the stapes superstructure is removed, footplate of stapes is perforated and a prosthesis is inserted into this perforation, which is attached to the long process of the incus by a loop or clip.[11]

The present study was undertaken to find the prevalence of otosclerosis among patients having deafness with intact tympanic membrane, to find the type and degree of hearing loss among the patients diagnosed with otosclerosis by using otoscopy, pure tone audiometry, tympanometry and HRCT temporal bone. To find association of otosclerosis with gender, to find the correlation of otosclerosis with age. The result of present study helps us to find out the prevalence of otosclerosis among patients having deafness with intact tympanic membrane, type of deafness and will throw a light on whether the otosclerosis is associated with gender.

## METHODS

This cross-sectional study was conducted in ESIC Medical College, Sanathnagar, Hyderabad. A total of 206 patients presenting with deafness and intact tympanic membrane were involved in this study. The ethical clearance was obtained from Institutional Ethical Committee (IEC). Written informed consent was obtained from all the patients fitting in inclusion criteria. The present study was conducted during the months of September 2022 and October 2022.

### *Exclusion criteria*

Patients with perforation of tympanic membrane, patients below 10 years and above 60 years old, patients not willing to give informed consent were excluded from the study.

Proper history including the demographic details (age, gender), chief complaints (hearing loss), present, past and family history of the patients was taken and then condition of the tympanic membrane was assessed using an otoscope. Patients whose tympanic membrane was intact were included in the study and were subjected for further investigations like Pure Tone Audiometry (PTA), tympanometry, high resolution computed tomography of temporal bone.

Diagnosis of otosclerosis was made, based on the findings of:

Otoscopy: Examination of both the ears of patients fitting in the inclusion criteria was done using an otoscope to check for the presence of increased redness of the promontory (flamingo flush or Schwartz sign) which is seen through the tympanic membrane. Patients who had positive Schwartz sign were diagnosed as active stage of otosclerosis and were subjected for further evaluation for conformation of the disease.[12]

Pure Tone Audiometry (PTA): Pure tone audiometry of all the patients fitting in the inclusion criteria was done in a soundproof room with the help of the audiologist. Presence of low frequency conductive hearing loss, dip in the bone conduction curve at frequency of 2000 HZ (Carhart's notch), gap between the air conduction and bone conduction curve were considered as the diagnostic criteria for otosclerosis.[13,14]

Tympanometry: Tympanometry was done for all the patients fitting in the inclusion criteria with the help of the audiologist. Patients who had as type of tympanogram was considered as positive for otosclerosis.

High Resolution Computed Tomography (HRCT) of temporal bone: Patients who had positive Schwartz sign on otoscopy, Carhart's notch and gap between the air conduction and bone conduction curve on pure tone audiometry. As type of tympanogram on tympanometry were subjected for high resolution computed tomography of temporal bone for conformation of otosclerosis. Patients with increased bony radiolucency in the otic capsule around the anterior foot plate, thickening of stapes, widening of oval window on HRCT temporal bone were diagnosed as positive for otosclerosis.[15]

### *Statistical analysis*

Done by using the SPSS software, comparison of the otosclerosis with gender was done by using chi square test and correlation of the otosclerosis with age was done by using spearman's correlation test. 'P' value of less than 0.05 was considered as statistically significant.

## RESULTS

A total of 206 patients belonging to the age group of 10 – 60 years were included in the present study. Subjects were selected from the patients presented to ENT outpatient department of ESIC Medical College, Hospital, Hyderabad. Subjects were distributed according to gender and age. 89 subjects were males and 117 subjects were females. 32 subjects were of 11-20 years

old, 67 subjects were of 21-30 years old, 53 subjects were of 31-40 years old, 40 subjects were of 41-50 years old, 14 subjects were of 51-60 years old.

**Table 1: Distribution of patients according to their diagnosis.**

| Diagnosis | Number of patients |
|---|---|
| **Otosclerosis** | 19 |
| **Acute secretory otitis media** | 57 |
| **Chronic secretory otitis media** | 36 |
| **Early stages of ASOM** | 84 |
| **Ossicular fixation** | 5 |
| **Ossicular dislocation** | 3 |
| **Middle ear tumours** | 2 |

Out of 206 patients, 19 patients were diagnosed with otosclerosis. Table 1 shows the distribution of patients according to their diagnosis. In that, 57 patients were diagnosed with acute secretory otitis media, 36 patients were diagnosed with chronic secretory otitis media, 84 patients were diagnosed with early stages of ASOM, 5 patients were diagnosed with ossicular fixation, 3 patients were diagnosed with ossicular dislocation, 2 patients were diagnosed with Middle ear tumors and 19 patients were diagnosed with otosclerosis

Out of 19 otosclerosis patients, 17 had bilateral otosclerosis and 2 had unilateral otosclerosis. The prevalence of otosclerosis among our study population is 9.2%**.** Unilateral was 0.97% and bilateral was 8.23%.

**Table 2: Distribution of patients diagnosed with otosclerosis according to gender.**

| Gender | Number of patients diagnosed with otosclerosis (%) |
|---|---|
| **Males** | 8 (3.9) |
| **Females** | 11 (5.3) |

Table 2 shows that, out of 19 (9.2%) patients diagnosed with otosclerosis, 8 (3.9%) were males and 11 (5.3%) were females. It tells that, in our study population, prevalence of otosclerosis is more among the females than in males.

Table 3 shows that, out of 19 (9.2%) patients diagnosed with otosclerosis, 6 (2.9%) belongs to the age group of 21-30 years, 8 (3.88%) belongs to the age group of 31-40 years, 3 (1.45%) belongs to the age group of 41-50 years, 2 (0.98%) belongs to the age group of 51-60 years. No patients between the age group of 11-20 years were diagnosed with otosclerosis.

It tells that, in our study population, prevalence of otosclerosis was highest among the age group of 31-40 years and least among the age group of 11-20 years.

**Table 3: Distribution of patients diagnosed with otosclerosis according to age.**

| Age (years) | Number of patients diagnosed withotosclerosis (%) |
|---|---|
| **11-20** | none |
| **21-30** | 6 (2.9) |
| **31-40** | 8 (3.88) |
| **41-50** | 3 (1.45) |
| **51-60** | 2 (0.98) |

**Table 4: Comparison of otosclerosis among males and females.**

| Gender | Otosclerosis | | |
|---|---|---|---|
| | **Positive** | **Negative** | **Total** |
| **Males** | 8 | 81 | 87 |
| **Females** | 11 | 106 | 117 |

**Table 5: Chi-square test.**

| Chi-square value | Degree of freedom | P value |
|---|---|---|
| **0.10** | 1 | 0.919 |

Comparison of otosclerosis among males and females was done by using Chi-Square Test [Table 4], [Table 5]. P value less than 0.05 was considered as statistically significant.

Table 5 shows that, P value of Chi-square test is 0.919. Which is greater than 0.05. It tells that, Chi-square Test for the association of gender and otosclerosis is not significant.

**Table 6: Correlation of otosclerosis with age.**

| | Correlation with | Spearman's Rho | P value | N |
|---|---|---|---|---|
| **Otosclerosis** | Age | -0.82 | 0.244 | 206 |

Correlation of otosclerosis was evaluated by using Spearman's correlation test [Table 6], considering P value of less than 0.05 was considered as statistically significant. The P value of our correlation test between otosclerosis and Age is 0.244 which is greater than 0.05. It tells that, the correlation of otosclerosis with age is not significant.

***Type and degree of hearing loss among the patients diagnosed with otosclerosis***

There were 19 patients diagnosed with otosclerosis, out of which 17 were having bilateral otosclerosis and 2 were having unilateral otosclerosis. Patients who were having unilateral otosclerosis has conductive deafness.

Patients who were having bilateral otosclerosis, 15 of them has conductive deafness and 2 of them has mixed deafness (both conductive and sensorineural).

And patients with mixed deafness were above 50 years old. We also found that the degree of hearing loss in patients diagnosed with otosclerosis was in between 30 to 50 dB.

## DISCUSSION

Our study was to find out the prevalence of otosclerosis among patients having deafness with intact tympanic membrane. Our study population belonged to the age group of 11-60 years old.

The prevalence of otosclerosis among our study sample (206) was 19 (9.2%) of which 8 (3.9%) were males and 11 (5.2%) were females.

Among the patients positive for otosclerosis 42% were males and 58% were females. The prevalence of otosclerosis was more between the age group of 31-40 years.

Choi et al (2021) did a retrospective review of patients in a large urban population of about 672,839 from January 2010 to August 2019 to find the prevalence of otosclerosis. They found that 134 patients of those population had otosclerosis. The average age at onset of otosclerosis was 46 years. And among the 134 otosclerosis patients 59% of them were females.[16]

Crompton et al (2019) did a study to analyze the epidemiology of otosclerosis in a British cohort collected between 2011 and 2017. He found that the prevalence of otosclerosis among women is 65% and men is 35%.[2]

He also found that 40% patients with positive family history of otosclerosis developed otosclerosis at earlier age. He stated that there is no association of measles infection with otosclerosis.

Arab et al (2001), studied epidemiology and etiology of population living in north-eastern states of Tunisia and reported that prevalence of otosclerosis in Tunisia varies from 0.4% to 0.8%. They stated that incidence of otosclerosis is high in the age group of 26-35 years and women of that age group were affected twice often as males.[17]

Our study showed that prevalence of otosclerosis is more among the age group of 31-40 years and both men and women of that age group were nearly equally affected with otosclerosis.

Many authors stated that otosclerosis is associated with gender (female preponderance) and age group (20-40years). Our study showed that otosclerosis is not associated with gender and age.

Our study also showed that 89.5% of the patients diagnosed with otosclerosis had conductive hearing loss and 10.5% of them had mixed hearing loss. None of them had exclusive sensorineural hearing loss.

And the degree of deafness among the otosclerosis patients was 30-50 dB. There is increase in the prevalence of otosclerosis according to our study when compared to the previous studies done by the other authors. This is because we have found the prevalence of otosclerosis exclusively in the patients having hearing loss and intact tympanic membrane, whereas other authors found the prevalence of otosclerosis in the general population.

This study has some limitations. Our study included only the insured persons and their family members under ESI scheme as our study was conducted in ESIC hospital. Male and female population size was not equal.

## CONCLUSION

Based on the results and the methodology employed, we have concluded that, in the present study on 206 patients presented to ENT outpatient department with hearing loss and intact tympanic membrane, between the age group of 11-60 years, the prevalence of unilateral otosclerosis was 0.97% and bilateral otosclerosis was 8.23%. Total prevalence of otosclerosis was 9.2%, out of which 3.9% were males and 5.3% were females and the Chi-Square test between otosclerosis and gender was not significant. By this we have concluded that otosclerosis is not associated with gender. According to age, out of 19 patients diagnosed with otosclerosis, 6 (2.9%) belonged to the age group of 21-30 years, 8 (3.88%) belonged to the age group of 31-40 years, 3 (1.45%) belonged to the age group of 41-50 years, 2 (0.98%) belonged to the age group of 51-60 years. No patients between the age group of 11-20 years had otosclerosis. And correlation of otosclerosis with age was not significant. By this we have concluded that, prevalence of otosclerosis was highest among the age group of 31-40 years and least among the age group of 11-20 years. And otosclerosis is not associated with age. We found that patients who were having unilateral otosclerosis has conductive deafness, patients who were having bilateral otosclerosis, 15 of them has conductive deafness and 2 of them has mixed deafness (both conductive and sensorineural). And patients with mixed deafness were above 50 years old. We also found that the degree of hearing loss in patients diagnosed with otosclerosis was in between 30 to 50 dB.

By this we have concluded that 89.4% of otosclerosis patients has conductive deafness and 10.6% of otosclerosis patients has mixed deafness.

*Funding: No funding sources*
*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee of ESIC Medical College and Hospital, Hyderabad*

## REFERENCES


1. Keefe DH, Archer KL, Schmid KK, Fitzpatrick DF, Feeney MP, Hunter LL. Identifying otosclerosis with aural acoustical tests of absorbance, group delay, acoustic reflex threshold, and otoacoustic emissions. J Amer Acad Audiol. 2017;28(09):838-60.
2. Crompton M, Cadge BA, Ziff JL, Mowat AJ, Nash R, Lavy JA, Powell HR, et al. The epidemiology of otosclerosis in a British cohort. Otol neurotol: Amer Otolog Soci Ame Neurotol Soc Euro Acad Otol Neurotol. 2019;40(1):22.
3. Huang TS, Lee FP. Surgically confirmed clinical otosclerosis among the Chinese. Arch Otolaryngol Head Neck Surg. 1988;114:538-44.
4. Cureoglu S, Schachern PA, Ferlito A, Rinaldo A, Tsuprun V, Paparella MM. Otosclerosis: etiopathogenesis and histopathology. Am J Otolaryngol. 2006;27:334-40.
5. Rudic M, Keogh I, Wagner R, Wilkinswon E, Kiros N, Ferrary E, Sterkers O, et al. The pathophysiology of otosclerosis: review of current research. Sci Direct (Hear Res). 2015;330:51-6.
6. Purohit B, Hermans R, Op de Beeck K. Imaging in otosclerosis: a pictorial review. Insights Imag. 2014;5:245-52.
7. Zhang Y, Tang Q, Xue R, Zhu X, Yang H, Gao Z. Analysis of the genetic characteristics of a chinese family with otosclerosis. Ear Nose Throat J. 2021;100(5_suppl):774S780S.
8. Metasch ML, Plontke SK, Zirkler J, Zahnert T. Diagnostik and operative Therapie der Otosklerose. Teil1: Grundlagen, Diagnostik und Differentialdiagnostik. Laryngo-Rhino-Otol. 2018;97:563-78.
9. Arndt O. Practice of otolaryngology, head and neck surgery. Georg Thieme Verlag; 2010:282-4.
10. de Oliveira Penido N, de Oliveira Vicente A. Medical management of otosclerosis. Otolaryngol Clin North Amer. 2018;51(2):441-52.
11. Plontke SK, Metasch ML, Zirkler J, Zahnert T. Diagnosis and surgical therapy of otosclerosis. Laryngo-rhino-otol. 2018; 97(10):717-34.
12. Lippy WH, Berenholz LP. Pearls on otosclerosis and stapedectomy. Ear Nose Throat J. 2008;87(6):326-8.
13. Lambert PR, eds. The Ear: Comprehensive Otology. Philadelphia, PA: Lippincott Williams and Wilkens; 2000:467-487.
14. Wegner I, Bittermann AJ, Hentschel MA, Van Der Heijden GJ, Grolman W. Pure-tone audiometry in otosclerosis: insufficient evidence for the diagnostic value of the Carhart notch. Otolaryngol-Head Neck Surgery. 2013;149(4):528-32.
15. Virk JS, Singh A, Lingam RK. The role of imaging in the diagnosis and management of otosclerosis. Otol Neurotol. 2013;34(7):e55-e60.
16. Choi JS, Sweeney AD, Alava I, Lovin BD, Lindquist NR, Appelbaum EN, et al. Otosclerosis in an urban population. Otol Neurotol. 2021;42(1):24-9.
17. Ben Arab S, Besbes G, Hachicha S. Otosclerosis in populations of northern Tunisia: epidemiology and etiology. Ann Otolaryngol Chir Cervicofac. 2001;118(1):19-25.


**Cite this article as:** Reddy Gangyada PK, Kishve S. Prevalence of otosclerosis among patients having deafness with intact tympanic membrane: a hospital based cross-sectional study. Int J Res Med Sci 2023;11:4160-4.