International Journal of Otorhinolaryngology and Head and Neck Surgery
Sinha A et al. Int J Otorhinolaryngol Head Neck Surg. 2023 Jul;9(7):530-535
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937
DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20231808

Original Research Article

Study of ossicular chain status in chronic otitis media patients at a tertiary care hospital in southern Bihar

Ankita Sinha*, Garima Singh, Ranbir K. Pandey, Deepak K. Gupta, Chandrakant Diwakar

Department of Otorhinolaryngology, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Received: 12 June 2023
Revised: 15 June 2023
Accepted: 19 June 2023

***Correspondence:**
Dr. Ankita Sinha,
E-mail: ankita17051992@gmail.com

ABSTRACT

Background: The objective is to assess the ossicular status and statistically evaluate the extent of ossicular destruction intraoperatively in chronic otitis media (COM) patients. Knowledge of pattern of involvement of ossicular chain in COM cases may help us to determine the type of reconstruction needed during surgery. The findings of this study could be exploited to predict preoperatively the probability of having ossicular chain destruction in COM ears and thus patients could therefore be properly consented about these potential issues before surgery.
Methods: Prospective observational study conducted over 2 years in diagnosed patients posted for surgical management and fulfilling the inclusion criteria. Intraoperative status of ossicles was noted for various types of COM and outcome was evaluated.
Results: Out of 92 patients, 59 (64.1%) had mucosal and 33 (35.9%) had squamosal disease. Ossicular chain was eroded in 41 cases (44.6%). 9 out of 59 (15.3%) mucosal cases and 32 out of 33 squamosal cases (97%) reported ossicular erosion. Most frequently involved was long process of incus (44.6%) >stapes (9.8%) >malleus (8.7%). Order of involvement (Austin-Kartush classification) was found as: type A (26.1%)>B (9.8%)>C (8.7%). 67.4% belonged in the group 15-30 years. Male: female ratio=1:1.5.
Conclusions: Degree of ossicular destruction is much greater in squamosal COM, owing to overproduction of cytokines and inflammatory mediators and due to presence of cholesteatoma and/or granulations. The long process of incus was found to be most vulnerable. Malleus was found to be the most resilient among all ossicles.

Keywords: Ossicular erosion, Chronic otitis media, Ossiculoplasty

INTRODUCTION

Chronic otitis media (COM) has been recognized indubitably as a pathology affecting the middle ear cavity since time long past. It has also been documented that the ear ossicles are likely to get involved in COM. COM is a permanent abnormality of the pars tensa (PT) or pars flaccida (PF), manifesting in the form of atelectasis, dimer formation, perforation, tympanosclerotic patches, retraction pockets or cholesteatoma.[1] It is usually a result of repeated bouts of unresolved acute otitis media, negative air pressure in the middle ear, or unresolved episodes of otitis media with effusion. The Browning classification of COM has been used for this study which broadly divides COM into mucosal and squamosal subtypes.[2] It has been further subdivided into active and inactive forms.

COM of all types is associated with varying degrees of erosion of the ossicular chain.[3] Ossicular destruction is more frequently encountered in cases of squamosal/unsafe type of COM, due to the presence of cholesteatoma and/or granulations.[4] Ossicular erosion has been seen to occur in COM even without cholesteatoma, yet ossicular destruction is seen more frequently when the keratinizing epithelium is present.[5] Factors that have been found

responsible in bone erosion in human cholesteatoma include osteoclasts, pressure necrosis, collagenolytic enzyme, tumour necrosis factor (TNF)-α, lysosomal enzymes, and non-lysosomal enzymes calpain I and II, which contribute to collagen destruction.[6-9] The most frequently accepted and used classification system is the Austin–Kartush system which applies to cases with an eroded incus, first proposed by Austin in 1971, and later modified by Kartush in 1994 has been applied in our study.[10,11]

Keeping the above factors in mind, we decided to conduct this study titled "study of ossicular chain status in COM patients at a tertiary care hospital in southern Bihar". This study would also aid us in predicting the possible ossicular erosion patterns in various types of COM cases thus enabling us to better prepare ourselves with various ossicular reconstruction tools and measures.

This study aims to assess the ossicular status and statistically evaluate the extent of ossicular destruction intraoperatively in COM patients.

METHODS

Ours is a prospective observational study conducted at Narayan Medical College and Hospital, Jamuhar, Rohtas, Bihar in the department of ENT over a period of 2 years (December 2020-December 2022). Sample population included all diagnosed patients of COM posted for surgical management during the study period fulfilling the inclusion criteria. Intraoperative status of ossicles was noted for various types of COM and outcome was evaluated**.** Frequency and percentage were calculated and tabulated. Data analysis was done using statistical package for the social sciences (SPSS) software (version 16.0). Patients aged more than 15 years with perforation undergoing middle ear operation with or without mastoid exploration were included in this study. Patients aged less than 15 years, revision cases, patients with malignancy of middle ear, congenital ear disorder, having ossicular fixation due to otosclerosis, patients with pathology of external ear and/or active infection in nose, throat and paranasal sinuses have been excluded from this study. Detailed history and clinical examination using tuning fork tests, otoscopy, microscope, oto-endoscopy was done. Tests for pre anaesthetic checkup, pure tone audiometry, impedance audiometry, X-ray mastoid bone Schuller's view and Towne's view, and/or high-resolution computed tomography (HRCT) of temporal bones, whenever required was done for each patient. Ethical approval was obtained from institutional ethical committee (IEC/2021/58).

RESULTS

Age distribution

Out of a total of 92 patients, 62 patients (67.4%) belonged to the age group 15-30 years, 16 patients (17.4%) belonged to the group 31-45 years and 14 patients (15.2%) belonged to the group >45 years (Figure 1).

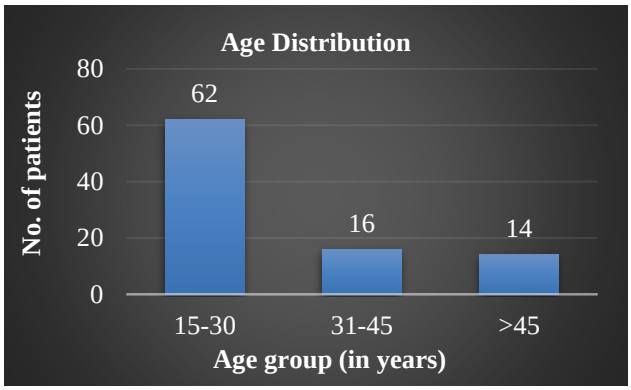

Figure 1: Age distribution.

Sex distribution

In my study, there were 36 males (39.1%) and 56 females (60.9%) (Figure 2).

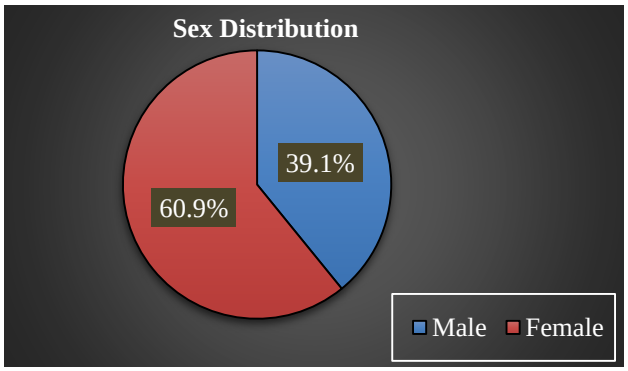

Figure 2: Sex distribution.

Type of disease

Out of a total of 92 patients, 59 patients (64.1%) had inactive mucosal COM, 27 patients (29.4%) had active squamous COM and 6 patients (6.5%) had inactive squamous COM (Figure 3).

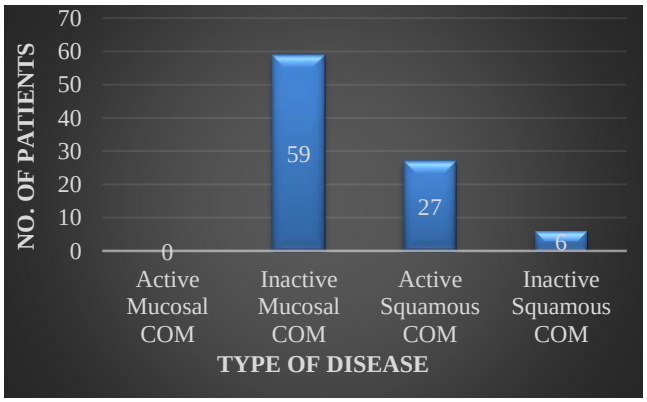

Figure 3: Type of disease.

Audiometry findings

The patients were classified according to their air-bone gap (A-B gap) on pure tone audiometry into 3 groups: <40 dB, 40-55 dB and >55 dB.76 patients (82.6%) belonged to the first group and 16 patients (17.4%) belonged to the second group. None of the patients belonged to the third group (Figure 4).

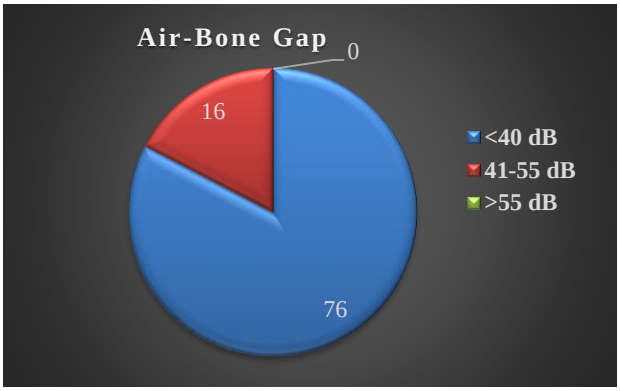

Figure 4: Air-bone gap.

Type of surgery performed

52 patients (56.5%) underwent tympanoplasty. Out of them,3 patients required ossiculoplasty. 8 patients (8.7%) underwent tympanoplasty with cortical mastoidectomy. Out of them,4 required ossiculoplasty.33 patients (35.9%) underwent canal wall down mastoidectomy. Out of them, ossiculoplasty was done in 32 of them. No patients underwent radical mastoidectomy or petrosectomy (Figure 5).

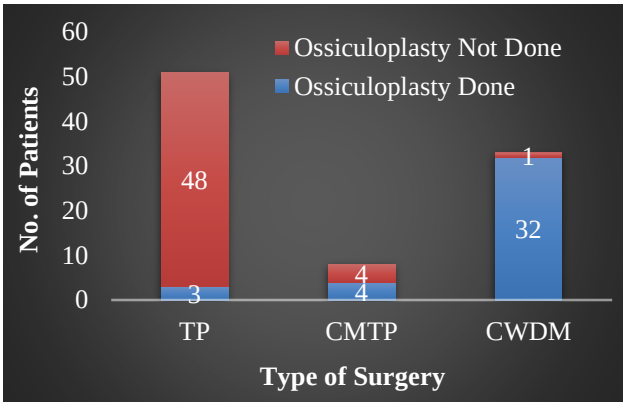

Figure 5: Type of surgery.

Ossicular chain status

Out of 92 patients, 59 patients (64.1%) belonged to the mucosal variety and 33 patients (35.9%) belonged to the squamosal variety of COM. Ossicular chain was found intact in 51 cases (55.4%) and ossicular chain erosion was noted in 41 cases (44.6%). Among the mucosal variety of COM, 9 out of 59 (15.3%) cases had ossicular chain discontinuity, whereas in the squamous variety of COM, 32 out of a total of 33 cases (97%) had ossicular chain erosion leading to discontinuity (Figure 6).

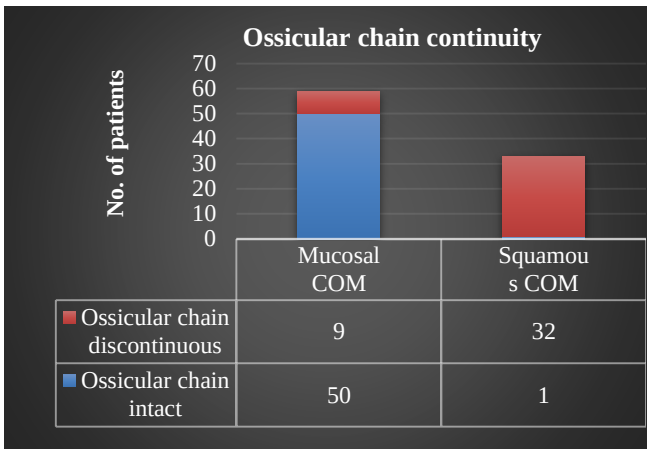

Figure 6: Ossicular chain status.

Status of individual ossicles

Malleus

Out of 92 cases, malleus was eroded in 8 cases (8.7%). Out of these, head of malleus was eroded in 2 cases (25%), handle was eroded in all8 cases and total malleus erosion was seen in 2 cases (25%) (Figure 7).

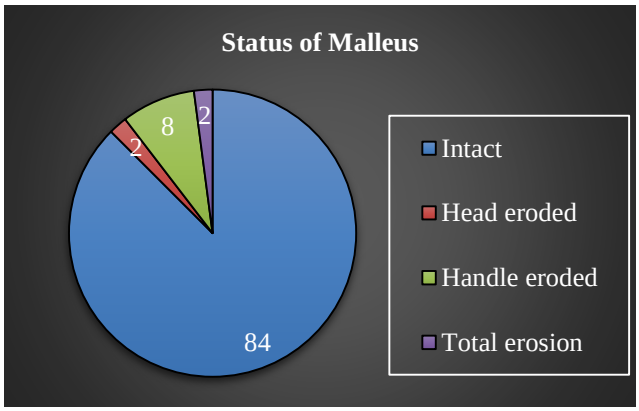

Figure 7: Status of malleus.

Incus

Out of 92 cases, incus was eroded in 41 cases (44.6%). Long and lenticular processes were seen eroded in all 41 cases. Body of incus was found eroded in 9 cases. Total incudal erosion was thus noted in 9 cases. No cases of isolated body of incus erosion were seen (Figure 8).

Stapes

Out of 92 cases, stapes superstructure was found eroded in 9 cases (9.8%) (Figure 9).

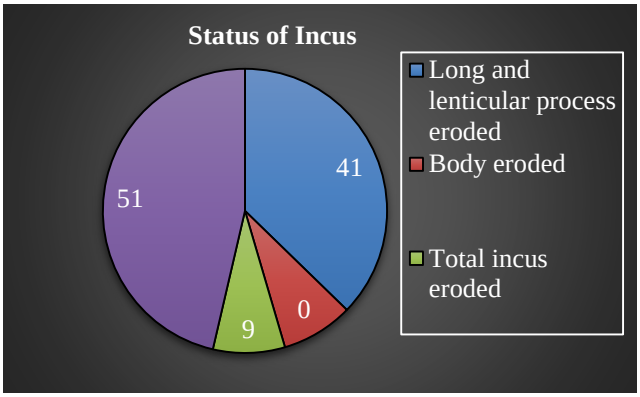

Figure 8: Status of incus.

Overall ossicular status

The ossicular chain status of 92 patients was classified according to the Austin-Kartush classification. Type O (M+I+S+) was noted in 51 cases (55.4%), type A (M+I-S+) was seen in 24 cases (26.1%), type B (M+I-S-) was noted in 9 cases (9.8%) and type C (M-I-S+) was noted in 8 cases (8.7%). No cases were reported as type D (M-I-S-).

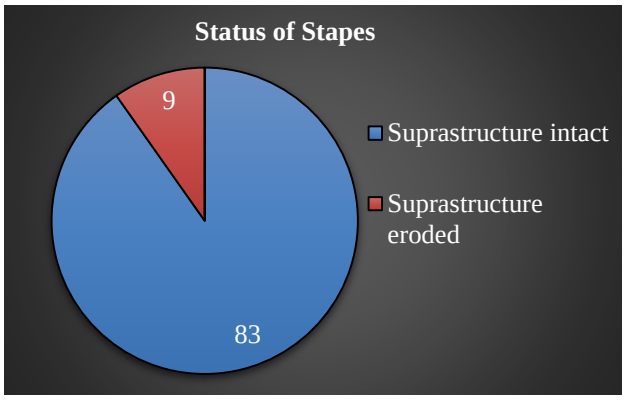

Figure 9: Status of stapes.

DISCUSSION

As late as the later part of the 20th century, ossicular chain defects in the middle ear was thought of as an outcome of pressure or adverse effects of squamous epithelium.[12] The 1970s witnessed shift of focus on the fact that ossicular chain involvement and its destruction was not just observed in ears with cholesteatoma and also concluded that the squamous epithelium not always led to erosion of bone and osssicles. Furthermore, inflammatory mediators were found to play a role in all such ossicular erosions.[13-15]

In this study, out of a total of 92 patients, 62 patients (67.4%) belonged to the age group 15-30 years, 16 patients (17.4%) belonged to the group 31-45 years and 14 patients (15.2%) belonged to the group 41-50 years. The greatest proportion of patients in our study were in the age group of 15–30 years. This was similar to study by Varshney et al in which the mean age was 29.78 years with SD 13.09.[16] The number of cases in the 16–25 years age group was 77 (51.33%), and this formed the largest group in the study.

In our study, the number of female patients slightly outnumbered the male patients (out of 92 patients, there were 36 males (39.1%) and 56 females (60.9%). Male to female ratio was 1:1.5. This was similar to studies by Gomaa et al and Ginni et al.[17,18] However, Aquino et al and Afolabi et al found a strong male predilection in squamous COM (males 64.7%; females 35.3%).[19,20]

Otoendoscopy and examination under microscope revealed 59 patients (64.1%) to have inactive mucosal COM, 9 patients (18%) had active squamous COM and 5 patients (10%) had inactive squamous COM. A few patients of active mucosal COM were encountered but they were not included in my study as they were not indicated for surgery.

Ossicular chain was found intact in 51 cases (55.4%) and ossicular chain erosion was noted in 41 cases (44.6%). Among the mucosal variety of COM, 9 out of 59 (15.3%) cases had ossicular chain discontinuity, whereas in the squamous variety of COM, 32 out of a total of 33 cases (97%) had ossicular chain erosion leading to discontinuity. Our findings are similar to those of Varshney et al who compared ossicular necrosis in safe and unsafe CSOM. In safe CSOM, 7.77% had ossicular damage, as against 85% in unsafe CSOM in their study.[16] In two studies on unsafe CSOM, Dasgupta et al also reported similar results.[21,22] Haider et al also found ossicular erosion to be more frequent in ears with cholesteatoma (69.3%) than in safe ears (13.9%).[23]

Out of 92 cases, malleus was eroded in 8 cases (8.7%). Out of these, head of malleus was eroded in 2 cases (25%), handle was eroded in all 8 cases and total malleus erosion was seen in 2 cases (25%).

Incus was found eroded in 41 cases (44.6%). Long and lenticular processes were seen eroded in all 41 cases. Body of incus was found eroded in 9 cases. Total incudal erosion was thus noted in 9 cases. No cases of isolated body of incus erosion were seen.

Stapes superstructure was found eroded in 9 cases (9.8%).

Out of a total of 59 mucosal cases, ossicular chain discontinuity was observed in 9 cases (15.3%). Long process of Incus was found eroded in all 9 cases, stapes suprastructure was found eroded in 2 cases and malleus was found necrosed in 1 case. Order of involvement in mucosal variety of COM was found as incus (15.3%) >stapes (3.4%) >malleus (1.7%).

Among the 33 squamosal cases, ossicular chain continuity was found lost in 32 cases (97%). Long and lenticular process of incus was found necrosed in 32 cases, stapes

suprastructure and handle of malleus was found equally involved in 7 cases, >stapes=malleus (21.2%).

Sade et al studied and opined that the process of ossicular erosion was multifactorial and that it was seemingly unrelated to the squamous epithelium.[13]

Tos in 1979 reported that squamous epithelium was present in close proximity with the eroded ossicles and that the squamous epithelium plays a significant role in bone resorption.[24]

The incidence of ossicular involvement in atticoantral variety was found as 82% by Sade et al in 1981, 80% by and Halevy and Sade, and 82.3% by Tos, respectively.[13,24,25] This was more or less similar to my study findings.

Sade et al had dedicated higher incidence of ossicular erosion in atticoantral disease to the granulation tissue being in firm contact with the ossicles and that the pocket formed was ideal for bacteria to thrive.[13]

Tos on the contrary had concurred with the prior anoxia-necrosis leading to bone resorption in chronic suppurative otitis media.[14,15,24] This was premised on the direct pressure by the cholesteatoma sac on the bone.

Limitations

Majority of our patients belonged to poor socioeconomic class. These neglected cases presented with greater duration of disease and hence greater degree of complications. Also, majority of our patients belonged to young age group (15-30 years) and hence the results cannot be generalised and applied on general population in full extent.

CONCLUSION

The study concludes that the degree of ossicular destruction was found much greater in squamosal variety of COM. Incudal erosion was the most commonly encountered defect. The long process of incus was found to be most vulnerable. Malleus was found to be the most resilient among all ossicles. In squamosal disease, malleal erosion was mostly observed in conjunction with incudal erosion due to the attical extension of cholesteatoma. Resorption of handle of malleus was found associated with subtotal perforations of the tympanic membrane. Exposure to external environment and decreased blood supply to the handle in such cases may be the reason.

This study would aid us in predicting the possible ossicular erosion patterns in various types of COM cases thus enabling us to better prepare ourselves with various ossicular reconstruction tools and measures.

The findings of this study could be utilised to predict the probability of having ossicular chain destruction in ears affected with COM preoperatively and thus patients could therefore be properly consented about these potential issues before surgery.

Recommendations

COM happens to be one of the most frequently encountered ear pathologies presenting to an otologist. This certainly seems to be the case, in our part of the world. A large section of population in our country belongs to lower socioeconomic group, and are ignorant thereby delaying medical intervention and later presenting with extensive ossicular involvement. As clinicians, we are concerned to treat this aggressively and do needful intervention to avoid complications.

Knowledge of pattern of involvement of ossicular chain in COM cases may help us to determine the type of reconstruction needed during surgery.

ACKNOWLEDGEMENTS

Authors would like to acknowledge the work of the esteemed faculty members, staff at the hospital and the college administration. They are also very grateful for the cooperation of the medical record department of the institute and the patients who helped in the smooth conduction of this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Gopen Q. Pathology and clinical course of the inflammatory diseases of the middle ear. In: Gulya AJ, Minor LB, Poe DS, editors. Glasscock-Shambaugh's surgery of the ear, 6th edition. PMPH, USA. 2010;427-8.
2. Browning GG, Weir J, Kelly G, Swan IRC. Chronic Otitis Media. In: Gleeson M, editor. Scott-Brown's Otorhinolaryngology, Head Neck Surgery. 7th edition. Hodder Arnold, Volume 3. 2008;237c:3395-445.
3. Mills RP. Management of Chronic Suppurative Otitis Media. In: Kerr, G.A. and Booth, J.B., Eds., Scott Brown's Otolaryngology, 3rd Edition, Butterworth-Heinemann, Oxford. 1997;1-11.
4. Proctor B. The Development of the Middle Ear Spaces and their Surgical Significance. J Laryngol Otol. 1964;78(7):631-45.
5. Thomsen J, Bretlau P, Balslev Jøorgensen M. Bone resorption in chronic otitis media. The role of cholesteatoma, a must or an adjunct? Clin Otolaryngol Allied Sci. 1981;6(3):179-86.
6. Chole RA. Cellular and subcellular events of bone resorption in human and experimental

cholesteatoma: the role of osteoclasts. Laryngoscope. 1984;94(1):76-95.
7. Chole RA, McGinn MD, Tinling SP. Pressure-Induced Bone Resorption in the Middle Ear. Ann Otol Rhinol Laryngol. 1985;94(2):165-70.
8. Abramson M. Collagenolytic activity in middle ear cholesteatoma. Ann Otol Rhinol Laryngol. 1969;78(1):112-24.
9. Amar MS, Wishahi HF, Zakhary MM. Clinical and biochemical studies of bone destruction in cholesteatoma. J Laryngol Otol. 1996;110(6):534-9.
10. Austin DF. Ossicular reconstruction. Arch Otolaryngol. 1971;94(6):525-35.
11. Kartush J. Ossicular chain reconstruction: capitulum to malleus. Otolaryngol Clin North Am. 1994;27(4):689-715.
12. Walsh TE, Covell WP, Ogura JH. The effect of cholesteatosis on bone. Ann Otol Rhinol Laryngol. 1951;60(4):1100-13.
13. Sade J, Berco E, Bugnover D, Brown M. Ossicular damage in chronic middle ear inflammations. Acta Otolaryngol. 1981;92(3-4):273-83.
14. Thomsen J, Jorgensen MB, Bretlau P, Kirstensen HK. Bone resorption in chronic otitis media. A histological and ultrastructural study I. Ossicular necrosis. J Laryngol Otol. 1974;88(10):975-81.
15. Tanaka K, Terayama Y, Hirai T. Electron microscopic study of bone lesions in cholesteatoma otitis. Arch Otorhinolaryngol. 1980;226:85-92.
16. Varshney S, Nangia A, Bist SS, Singh RK, Gupta N, Bhagat S. Ossicular chain status in chronic suppurative otitis media in adults. Indian J Otolaryngol Head Neck Surg. 2010;62:421-6.
17. Gomaa MA, Abdel Karim ARA, Abdel Ghany HS, Elhiny AA, Sadek AA. Evaluation of Temporal Bone Cholesteatoma and the Correlation Between High Resolution Computed Tomography and Surgical Finding. Clin Med Insights Ear Nose Throat. 2013;6:21-8.
18. Datta G, Baisakhiya N, Mendiratta V. Unsafe CSOM still a challenge in rural areas. Otolaryngol Online J. 2014;4:1-16.
19. Aquino JE, Cruz Filho NA, de Aquino JN. Epidemiology of middle ear and mastoid cholesteatomas: study of 1146 cases. Braz J Otorhinolaryngol. 2011;77:341-7.
20. Afolabi OA, Salaudeen AG, Ologe FE, Nwabuisi C, Nwawolo CC. Pattern of bacterial isolates in the middle ear discharge of patients with chronic suppurative otitis media in a tertiary hospital in North central Nigeria. Afr Health Sci. 2012;12:362-7.
21. Dasgupta KS, Joshi SV, Lanjewar KY, Murkey NN. Pars tensa& attic cholesteatoma: are these the two sides of a same coin? Indian J Otol. 2005;11:22-6.
22. Dasgupta KS, Gupta M, Lanjewar KY. Pars tensa cholesteatoma: the underestimated threat. Indian J Otol. 2005;11:17-20.
23. Haidar H, Sheikh R, Larem A, Elsaadi A, Abdulkarim H. Ossicular Chain Erosion in Chronic Suppurative Otitis Media. Otolaryngol (Sunnyvale). 2015;5:203.
24. Tos M. Pathology of ossicular chain in various chronic middle ear diseases. J Laryngol Otol. 1979;93(8):769-80.
25. Halevy A, Sade J. The aetiology of bone destruction in chronic otitis media. J Laryngol Otol. 1974;88(2):139-436.

Cite this article as: Sinha A, Singh G, Pandey RK, Gupta DK, Diwakar C. Study of ossicular chain status in chronic otitis media patients at a tertiary care hospital in southern Bihar. Int J Otorhinolaryngol Head Neck Surg 2023;9:530-5.