

Comparison of Structural Alterations of Incus Bone Between Middle Ear Cholesteatoma and Temporal Bone Osteitis Among Patients Who Underwent Mastoid Exploration in Services Hospital, Lahore

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Abstract

Objective: To compare the structural changes of incus bone between middle ear cholesteatoma and temporal bone osteitis among patients who underwent mastoid exploration in Services hospital, Lahore.

Material and Methods: An analytical and hospital based comparative study carried out at ENT- II Services Hospital Lahore during July 2023 to December 2023 for 6 months. Total 60 patients were selected. Random allocation of study participants were done in two groups, Group A and Group B. Each group had 30 patients. Patients with middle ear cholesteatoma were in group A, while all patients in group B had middle ear temporal bone osteitis. A mastoid X-ray displaying haziness of mastoid air cells and CT scan demonstrating the intracranial and extracranial extrusion were carried out. SPSS 20 was used to analyze all data.

Results: The study's cases had an average age of 31.00 ± 11.07 years. With a p-value of 0.322 (> 0.05), the mean age of two groups was statistically equal. In this study, there were 26 (43.3%) male cases and 34 (56.7%) female cases, with female to male ratio of 1.31 and 1. All groups had structural alterations in Incus bone. Long process was seen in 16(26.7%) cases, Lenticular process was seen in 25(41.7%) of the cases, there were 14(23.3%) cases who had short process and in 5(8.3%) cases all were eroded.

Conclusion: The results of this study demonstrated strong correlation between localized middle ear cholesteatoma and temporal bone osteitis and alterations in incus bone.

Keywords: Cholesteatoma, Incus bone, Mastoid exploration, Temporal bone osteitis

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Introduction

A cholesteatoma is a lesion that causes damage to the underlying tissues and has three-dimensional epidermal structures. It tends to return after removal and can cause hearing loss, bone degradation, otorrhea,

facial nerve paralysis, and intracranial problems. As much as 50 dB of conductive hearing loss can result from osseous erosion.^{1,2} Cholesteatoma leads to conductive hearing loss by eroding the incus bone, a component of the ossicular chain.³ The clinical examination just shows the tip of the iceberg in terms of the disease's scope. Common bones called osseous bones were deteriorated in cases of middle ear cholesteatoma and chronic suppurative otitis media.⁴ 50 dB conductive hearing loss may result from ossicular erosion; hearing loss more than 60 dB is considered sensorineural. One definition of chronic suppurative otitis media is a persistent infection of the middle ear cleft's mucosa. The eustachian tube, hypotympanum, mesotympanum, epitympanum, aditus, and mastoid air cell system are among the struc-

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tures affected by middle ear cleft. They are challenging to treat due to the surrounding necrotic skin margins.⁵ Choleatoma is the first sign of chronic suppurative otitis media, which leads to automastoidectomy. Ventilating the mastoid is well documented to alter the course of a disease and stop its consequences.⁶ A histological examination indicates a considerable proliferation of capillaries and the infiltration of histocytes containing lysosomal enzymes, including acid phosphatase, protease, hyaluronidase, and cathepsin. Ossicles are frequently damaged by chronic suppurative otitis media, and 78% of patients usually experience multiple ossicular injury.⁵ Thirty percent of middle ear cases are cholesteatoma.⁷ There is reported to be a high percentage of ossicular injury (56%), in chronic suppurative otitis media.⁸ A 50 dB conductive hearing loss might result from lenticular process erosion. The most common defect of the ossicular chain is cholesteatoma, which causes erosion of the long process of the incus. Rather than its flimsy blood supply, the reason is owing to its fragile construction and location. Examining patients who had a history of hearing loss allowed results to be compared with preoperative and intraoperative findings to assess the diagnostic utility of the ossicular chain. It was discovered that the incidence of ossicular destruction in adults and children is comparable.⁹ Loss of hearing is a frequent consequence. The majority of patients find surgery beneficial. An extensive and ongoing follow-up programme is necessary for patients suffering from ossicular necrosis.¹⁰ Cholesteatoma is associated with conductive hearing loss both before and after surgery, if the surgeon removes portions of the ossicular chain, as the mass may encircle and erode the bones.¹¹ The type of surgery can also have an impact on hearing. Generally, superior hearing results result from stapes preservation.

The purpose of this study is to provide information regarding the initial stages of cholesteatoma and localised middle ear temporal osteitis. Ossicles can be destroyed by middle ear granulation tissue, which is a result of temporal bone osteitis.¹² Granulation tissue, cholesteatoma, or both may be the cause of the distinctive skeletal abnormalities seen in CSOM. Many theories have been proposed to explain the mechanism of bone degradation, including pressure necrosis, infection, hypermic decalcification, enzymatic, chemical, and immunological.¹³ Ossicles have not yet been the subject of a comparison research due to the distinct natures of the two diseases. This study can assist to prioritise the early treatment of these problems in order to spare

patients from deafness, which is one of the major disabilities in the world, as well as from potentially fatal disease consequences.

Materials and Methods

An analytical and hospital based comparative study was carried out at the Services Hospital Lahore's ENT Unit II. This study was conducted from July 2023 to December 2023 for 6 months. A random non-probability convenient sampling technique was used to pick a sample size of 60 patients who met the inclusion criteria (30 patients in each group). The sample size was estimated using a 10% level of significance and a 90% test power, with a 61% expected proportion of cholesteatoma and a 27% expected granulation. On a predesigned proforma, information from clinical examination, investigations, imaging and personal data were recorded. By employing a table of random numbers, the patients were split into two groups: group A and group B. Every group consisted of thirty patients. Group A consisted of all patients with middle ear cholesteatoma, while group B included patients with middle ear temporal bone osteitis. Following the taking of a medical history, an ossicular chain and tympanic membrane status as well as an atticofacial illness diagnosis were made by means of a microscope examination of the ear. The degree of hearing loss was determined using pure tone audiometry. A CT scan demonstrating intracranial and extracranial extension, as well as a mastoid X-ray displaying the haziness of mastoid air cells, were carried out. A mastoid exploration was conducted, and the condition of the incus bone was recorded for both conditions.

Results

There were 26(43.3%) male and 34(56.7%) female cases in this study with ratio female to male ratio of 1.31 and 1. In Localized Middle Ear Cholesteatoma and Temporal bone Osteitis group there were 13(43.33%) male and 17(56.67%) female in each group. The mean age of cases in this study was 31.00 ± 11.07 years while mean age in Localized Middle Ear Cholesteatoma was 32.40 ± 12.16 years and in Temporal bone Osteitis group were 29.60 ± 9.88 years. The mean age in both groups was statically same, p -value = 0.322 (> 0.05). Structural changes of Incus bone were in all groups were seen. Long process was seen in 16(26.7%) cases, Lenticular process was seen in 25(41.7%) of the cases, there were 14(23.3%) cases who had short process and in 5(8.3%) cases all were eroded. According to incus bone changes

in Localized Middle Ear Cholesteatoma 4(13.3%) had long process, 13(43.3%) had lenticular process, 8(26.7%) had short process and 5(16.7%) had all erosions while in Temporal bone Osteitis group 12(40%) cases had long, 12(40%) had lenticular 6 (20%) had short process. On applying Chi-square test we found significant association between Long process and lenticular process with temporal bone osteitis while lenticular process

Table 1: Descriptive Statistics of age (years) in both study groups.

	Mean	S.D	Min.	Max.
Localized Middle Ear Cholesteatoma	32.40	12.16	18	56
Temporal bone Osteitis	29.60	9.88	18	50
Total	31.00	11.07	18	56

Table 2: Comparison of Changes in incus bone in both study groups

Changes in incus	Study groups		Total
	Localized Middle Ear Cholesteatoma	Temporal bone Osteitis	
Long process	4	12	16
	13.3%	40.0%	26.7%
Lenticular process	13	12	25
	43.3%	40.0%	41.7%
Short process	8	6	14
	26.7%	20.0%	23.3%
All eroded	5	0	5
	16.7%	.0%	8.3%

was also higher in Localized Middle Ear Cholesteatoma, p-value 0.025 (< 0.05).

Discussion

Since prehistoric times, chronic suppurative otitis media has been a significant contributor to middle ear illness. It is one of the most prevalent ear conditions in developing nations, it signifies the final phase of the otitis media illness continuum and is distinguished by an irreversible alteration in the middle ear cleft.¹⁴ The prevalence of CSOM varies greatly among emerging nations, ranging from 0.4% to 33.3%.¹⁵ About 80% of patients with cholesteatoma have partial or complete ossicle degradation, whereas 20% of individuals with chronic otitis media without cholesteatoma have ossicular chain erosion. Cholesteatomas have a high death and morbidity rate, can lead to intratemporal and cerebral problems,

and erode bone.¹⁴

There are basically four main types of ossicular malformations. The most prevalent one involves simply the long process of the incus, leaving the malleus and stapes intact. Loss of incus and erosion of the stapes suprastructure are the second most prevalent defects. Third, the malleus handle and stapes are unaffected by the cholesteatoma that is expanding into the middle ear. Lastly, all ossicles may disappear, with the exception of the stapedial foot plate. Erosion of the long process of incus by cholesteatoma appears to be the most frequently encountered defect of the ossicular chain. The reason is because of its delicate structure rather than its tenuous blood supply.¹² Under a microscope, surgical procedures reveal the shattered ossicles. Another test for conductive hearing loss is the tuning fork test. However, when the ossicular chain is intact or a cholesteatoma fills the space left by the damaged ossicles, hearing may occasionally be normal.¹⁶ Furthermore, partial or complete ossicular chain resorption is frequently linked to an active mucosal COM. Resorptive osteitis could be the cause of this. The impacted ossicles usually exhibit hyperemia, prominent histiocytes, and capillary growth. Usually, the manubrium, stapes crurae, body of the incus, and long process of the incus erode first.¹⁷

A study was conducted recently to document the different histological alterations linked to chronic otitis media. Following staining with hematoxylin and eosin, ten normal and ten diseased incuses that were removed during the surgery for chronic otitis media (both with and without cholesteatoma) were examined histologically. According to the study's findings, a normal incus had a compact bone pattern with concentric rings, just like any other long bone in the body. Similar alterations were observed in the pathological incuses of chronic otitis media (with and without cholesteatoma), including stratified squamous epithelium with deformed concentric rings and expanded osseous gaps.¹⁸ Males had a higher incidence of cholesteatoma (60%) compared to females (40%), with 53.33% of patients falling into the younger age range (21-35 years). Just 10% of instances had intact ossicles, whereas 90% of cases had ossicular erosion. In 15% of the instances, the incus was gone, and in 75% of the cases, it had deteriorated. It was also noted that the malleus was the ossicle that was least likely to dissolve.²⁰ When comparing instances between the ages of 18 and 56, we currently have more female cases than male ones. The study's mean age of cases was determined to be 31.00±11.07 years.

In the current investigation, we discovered that 16 instances (26.7%) had long processes, 25 cases (41.7%) had lenticular processes, 14 cases (23.3%) had short processes, and 5 cases (8.3%) had all of them corroded. In a similar study, 60 patients of cholesteatoma, regardless of age or gender, were chosen throughout the course of a two-year study period, and their intraoperative ossicular status was noted. In decreasing order, the study's findings indicate that the following osseous structures and their components are implicated in cholesteatoma cases: the lenticular process (in 50 cases, or 83%), the long process of the incus (in 49 cases, or 81.67%), the stapes super-structure (in 29 cases, or 48.33%), the body of the incus (in 26 cases, or 43.33), the head of the malleus (in 23 cases), and the handle of the malleus (in ten cases, or 16.67%).¹⁹

These results are consistent with the current research, as in our study, lenticular processes were observed in fewer cases in both groups, as were long, short, and entire erosions. Furthermore, a second study was conducted solely to assess the state of the ossicular chain in individuals who needed surgery for cholesteatoma. The study's findings showed that the most prevalent pathology was whole (55.4%) or partial (30.7%) incus erosion. The body of incus (4.8%) and the lengthy procedure (25.9%) were occasionally also involved. The stapes superstructure was more frequently eroded than the bone was completely lost (40.9% vs. 25.9%). The malleus had the least amount of erosion. In 5.5% of cases, the ossicles were found to be completely intact. The most frequent combination of ossicular erosion was incudostapedial erosion (18%) and total ossicular erosion with an undamaged footplate (18.7%). 85% of patients with multiple site involvement had advanced disease when they were diagnosed with incudostapedial erosion. According to the study, there is a higher risk of ossicular erosion and poor hearing outcomes when there is widespread cholesteatoma.¹¹

Only a few differences, such as the long, lenticular, and short processes, were seen in the two study groups. We further separated our targeted cases into two groups and discovered that, in the Temporal bone Osteitis group, 12 cases (40%) had long processes, 12 cases (20%) had lenticular processes, and 4 cases (13.3%) had long processes, 13 cases (43.3%) had lenticular processes, 8 cases (26.7%) had short processes, and 5 cases (16.7%) had all erosions. Using the Chi-square test, we discovered a significant correlation (p-value 0.025; < 0.05) between study groups and changes in incus bone. High

resolution CT scans are needed for additional research in order to see any changes in the incus bone, which can yield useful data.

Conclusion

The results of this study demonstrated a strong correlation between the lenticular process and the long process in cases of temporal bone osteitis, and a greater incidence of lenticular process in cases of localized middle ear cholesteatoma. Therefore, early middle ear granulation detection can help us make the right management decisions, which can ultimately result in effective treatment and positive prognosis outcomes.

Conflict of interest

None

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References

1. Gilberto N, Custódio S, Colaço T, Santos R. Middle ear congenital cholesteatoma: systematic review, meta-analysis and insights on its pathogenesis. *Otology* 2020; 277: 987–998.
2. PR Møller, CN Pedersen, LR. Grosfjeld. Recurrence of Cholesteatoma - A Retrospective Study Including 1,006 Patients for More than 33 Years. *Int Arch Otorhinolaryngol* 2020;24:e18–e23.
3. F Gulustan, , ZM Yazici, I Sayin. Evaluation of the Presence of Sensorineural Hearing Loss and the Relationship with Intraoperative Findings in Cholesteatoma. *Ear, Nose & Throat Journal*. 2021; 100(3S): 249S–252S.
4. W Javaid, M. Naeem, ST Bukhari. Comparison of Preop High Resolution CT Temporal Bone Findings with Intraoperative Findings in Cholesteatoma. *PJMHS* 2023; 17(05): 35-37.
5. Y Reuven, E Raveh, D Ulanovski. Congenital cholesteatoma: Clinical features and surgical outcomes. *International Journal of Pediatric Otorhinolaryngology* 2022; 156: 111098.
6. U Saini , PK Saidha, G Singal. Automastoidectomy: a rare autocorrected chronic suppurative otitis media sequelae. *otorhinolaryngology clinics: An International Journal* 2023; 15 (1): 19-24.
7. A Roy, S Maji, YR Dhir. Pre operative HRCT of middle ear pathology with particular reference to intra-operative findings in cholesteatoma. *Int J Acad Med Pharm* 2023; 5 (3): 2303-2307.
8. TTD, AV Bhatt. Ossicular chain status in ear pathology cases. *Medica Innovatica* 2022;1 (2):130

9. D Kumar, S Manorama. Intraoperative status of ossicles in patients of chronic suppurative otitis media: a study of 150 cases. *JDMS* 2020; 19 (5): 21-24.
10. S Pant, VK Agarwal, SS Bist. Pre-Operative Predictors of Ossicular Status in Chronic Suppurative Otitis Media. *Journal of Advanced Zoology* 2023; 44: 12.
11. B Wei, P Zhou, Y Zheng. Congenital cholesteatoma clinical and surgical management. *International Journal of Pediatric Otorhinolaryngology* 2023; 164: 111401.
12. JJ Lindeboom, PMW van Kempen, J Buwalda. Mastoid obliteration with hydroxyapatite vs. bone pâté in mastoidectomy surgery performed on patients with cholesteatoma and chronic suppurative otitis media: a retrospective analysis. *Otology* 2023; 280: 1703-11.
13. S Xie, Z Pan, T Yin. Expression of PTHrP and RANKL in acquired middle ear cholesteatoma epithelium. *Acta Oto-Laryngologica* 2020; 14(5): 351-355.
14. M S Islam, M B Ahmed, N Khan. Sociodemographic Factors of Atticoantral Chronic Suppurative Otitis Media. *Bangladesh J Otorhinolaryngol* 2020; 26(2): 136-141.
15. P Gupta, S Varshney, SK Kumar. Chronic Suppurative Otitis Media A Microbiological Review of 20 Years. *Indian Journal of Otology* 2020; 26(2): 59-67.
16. MG Sundar, M Gnanasekar, C Arunraj. Evaluation of different types of ossicular pathologies and their treatment with cartilage tympanoplasty in csom patients. *Int J Acad Med Pharm* 2023; 5 (4); 781-784.
17. R Hidayat. Pathophysiological to clinical aspects of chronic suppurative otitis media (csom): narrative literature review. *Archives of The Medicine and Case Reports* 2022; 3(2):246-255.
18. F Christianty, A D Wahyudiono. Management of recurrent chronic suppurative otitis media with cholesteatoma. *Oto Rhino Laryngologica Indonesiana* 2023; 53 (1): 89-96.
19. W Javaid, A Rashid, MUK Amin. Frequency of incus bone erosion on mastoid exploration in chronic suppurative otitis media with middle ear cholesteotoma. *P J M H S* 2021; 15 (6):1426-28.
20. AH Nair, R Jose, M Kumar. Comparison of ossicular chain status by pre-operative cone beam computed tomography (CBCT) with intra-operative findings in patients with conductive hearing loss. *EJENTAS* 2023; 24 (24): 1-9.

Authors Contribution

SMG: Conceptualization of Project

JA: Data Collection

SOF: Literature Search

MN: Statistical Analysis

JA, BR: Drafting, Revision

TA: Writing of Manuscript