Section: ENT

Original Research Article

POST-OPERATIVE SENSORINEURAL HEARING LOSS AFTER MIDDLE EAR SURGERY in a TERTIARY CARE CENTRE OF JHARKHAND

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ABSTRACT

Background: Acoustic damage and ossicle manipulation are common causes of sensorineural hearing loss (SNHL), a frequent consequence of middle ear surgery. Inner ear injury can occur during several surgical operations and is a typical complication of chronic otitis media (COM), a middle ear illness. Serious noise-induced hearing loss has also been reported. Given the unpredictable and inevitable nature of SNHL, it is imperative for otologists to perform hearing evaluations following mastoid drilling. This study aimed to evaluate bone conduction thresholds after middle ear surgery and compare them with pre-operative thresholds.

Methods and Materials: From November 2023 to January 2025, MGM Medical College Jamshedpur, a tertiary care center's otolaryngology department, conducted a cohort study. The patients underwent a thorough examination, including otoscopy and microscopic examination. We performed pre- and post-operative hearing evaluations and recorded the air and bone conduction thresholds at various frequencies. The results were reported as the mean and standard deviation. We analysed the data using a p-value of less than 0.05.

Results: Post-operative Sensorineural hearing loss was not observed, and there was no statistically significant difference between the pre and post-operative values of the bone conduction threshold. None of, the patients experienced sensorineural hearing loss following surgery.

Conclusion: Research indicates that bone conduction threshold values remain stable after middle ear surgery, typically disappearing after three months. Post-operative sensorineural hearing loss can be prevented with proper surgical techniques and pre-operative counseling.

Keywords: Post-operative Sensorineural hearing loss, Middle ear surgeries, Chronic otitis media, Bone conduction.

INTRODUCTION

Chronic suppurative otitis media (CSOM),[1] is a serious condition that requires surgery to eradicate the disease from the mastoid air cell system. Despite advances in surgical techniques, instruments, and monitoring devices, mild sensorineural hearing loss remains a significant post-surgical issue. This is due to the difficulty in measuring patients' hearing thresholds immediately post-operatively, which can lead to infections and discomfort. Therefore, proper understanding of this issue is crucial for effective treatment.

The prevalence of post-operative sensorineural hearing loss (SNHL) following surgery varies from 1.2% to 16.7%.[2] Permanent SNHL occurs in 1.2-

4.5%,[3] of cases after tympanomastoid surgery, while 1.2% occurs after chronic otitis surgery, with 0.5% becoming deaf and 0.7% experiencing high tone loss.[4] SNHL rates after coronary artery bypass graft (CABG) range from 1-15%, but some studies suggest that modern techniques may reduce the incidence.[5]

Potential causes of permanent sensorineural hearing loss following tympanomastoid surgery include harm to the delicate inner ear structures caused by cholesteatoma or granulation removal from round or oval windows, acoustic trauma from drill noise or suction, opening of the lateral semicircular canal to create a labyrinthine fistula, and accidental contact with the ossicles by a rotating burr.

Bone drilling and suctioning are crucial parts of ear surgery; however, they can be noisy and vibrate the cochlea. The contralateral cochlea may be 80-85 dB quieter than the exposed cochlea, which may be 90-100 dB louder. This vibration can potentially harm the cochlea. Even though the current drilling equipment is quieter, high-pressure infiltration can still damage the ossicles, labyrinth, and cochlea. Drilling and suction may worsen the painful vibrations felt by the cochlea. The extremely loud noises that patients are subjected to during ear surgery can cause both acute and permanent hearing loss. One common cause of high-frequency sensorineural hearing loss is accidental drilling of the ossicular chain. Both ears experience acoustic stress, even though the unoperated ear is exposed to only 5-10 dB less noise during otological drills. [6-8]

Middle ear surgery is an option for patients with conductive hearing loss. Mild sensorineural hearing loss, which is often unnoticed and resolves on its own, is common after middle ear surgery, according to multiple studies. There has been no study on sensorineural hearing loss after surgery in the Jharkhand population. If a patient experiences post-operative sensorineural hearing loss, an otology clinic can help diagnose the condition and determine its causes. The fact that middle ear procedures might cause permanent sensorineural hearing loss is something we need to take very seriously. Therefore, this research is necessary to determine how often sensorineural hearing loss occurs following middle ear surgery, how good the prognosis is, what causes it, and how to avoid it. This study evaluated the bone conduction thresholds before and after middle ear surgery.

MATERIALS AND METHODS

This hospital-based cohort study was conducted at MGM Medical College & Hospital Jamshedpur, India, from November 2023 to January 2025, focusing on patients with chronic suppurative otitis media who underwent middle ear surgeries. Patients who had sensorineural hearing loss before surgery, were exposed to loud noises at work, had a history of using ototoxic medications, had middle ear surgery before surgery, or had ear discharge after surgery were not included in the study. This department identified post-operative cases of CSOM under regular follow-up in otology clinics as the target population. We enrolled patients who had taken up the graft, had no post-operative discharge, or were willing to participate in the study. The study included 72 patients who visited the Outpatient Department (OPD) of otorhinolaryngology. We obtained informed consent from all participants involved in the study.

The study included three surgical procedures: tympanoplasty, modified intact canal wall mastoidectomy, tympanoplasty (MICT), and modified radical mastoidectomy (MRM). We obtained a detailed clinical history to determine the duration and frequency of otorrhea and hearing loss. We conducted thorough general and otorhinolaryngological examinations. The affected ear was examined using an otoscope and a microscope. All patients underwent pure pure-tone audiometry pre-operatively.

We performed pre and post-operative hearing evaluations in a sound proof audiometry room. We recorded the air and bone conduction thresholds of all patients at 0.5, 1, 2, and 4 kHz. We reported hearing results as the mean and standard deviation of air conduction and bone conduction thresholds.

Statistical analyses were performed using SPSS version 24. We employed a paired t-test and repeated-measures ANOVA to analyze continuous variables. Statistical significance was set at $P < 0.05$.

The Institutional Ethics Committee of the MGM Medical College, Jamshedpur, Jharkhand, approved the study and conducted it in accordance with the Declaration of Helsinki. (IEC approval no: IEC/04/21, dated: June 23, 2021). Registration Number: ECR/1621/Inst./JH/2021. After explaining the procedure and its complications to all patients, they gave their consent for surgery.

RESULTS

The study was conducted on 72 patients with CSOM; of whom 38 (52.8%) were females and 34 (47.2%) males. The age of the patients included in the study ranged from 9 to 50 years, with a mean age of 28.32 ± 11.14 years. The most common age group was 9-29 years, with 42 patients (58.3%). The most common complaint was ear discharge, which was present in all patients. Table 01, Figure 01. Most patients belonged to the low monthly income group. Figure 02. Figure 03 shows the change in mean preoperative and postoperative thresholds with frequency.

This table shows the mean bone conduction thresholds for both the pre-operatively and post-operatively frequencies (day 60). No significant changes were observed at 500 Hz and 1000 Hz, highlighting frequency-specific effects; however, surgical intervention significantly improved the

bone conduction thresholds at 2000 Hz (p = 0.007). Table 02 and Figure 04.

Repeated measures ANOVA showed no overall variation in improvements across frequencies; however, the interaction between condition (pre- and post-operative) and frequency was significant (p = 0.002), suggesting differential impacts of surgery depending on the frequency. Table 03 and Figure 05.

Additionally, a one-way ANOVA revealed no significant differences in post-operative outcomes based on the side of the disease (right, left, or bilateral), indicating uniform efficacy across patient groups. These findings suggest that, while surgical outcomes are generally positive, the benefits are most pronounced at higher frequencies, warranting further exploration of the clinical implications of frequency-dependent improvements. [Table 04 and Figure 06].

Table 1: Distribution of Age and sex of study participants

Age	*n[%]*	Mean	Standard Deviation
9-19 years	15[20.8%]	28.32	11.14
20-29 years	27[37.5%]		
30-39 years	14[19.4%]		
40-50 years	16[22.2%]		
Sex			
Female	38[52.8%]		
Male	34[47.2%]		

Table 2: Distribution of Statistics of Pre- and Post-Operative Bone Conduction Thresholds

Frequency	t-Statistic	P-value
500 Hz (0.5 kHz)	1.526	0.132
1000 Hz (1 kHz)	0.000	1.000
2000 Hz (2 kHz)	-2.791	0.007
P-value < 0.05 is statistically significant		

Table 3: Distribution of Statistics of improvements across frequencies of Pre- and Post-Operative Bone Conduction Thresholds

Effect	F-Statistic	P-value
Condition (Pre vs. Post)	1.128	0.292
Frequency	2.528	0.083
Condition × Frequency	6.494	0.002
P-value < 0.05 is statistically significant		

Table 4: Distribution of Statistics of post-operative outcomes based on the side of the disease (right, left, or bilateral) Bone Conduction Thresholds

Frequency	F-Statistic	P-value
500 Hz (0.5 kHz)	0.716	0.492
1000 Hz (1 kHz)	0.277	0.759
2000 Hz (2 kHz)	0.939	0.396
P-value < 0.05 is statistically significant		

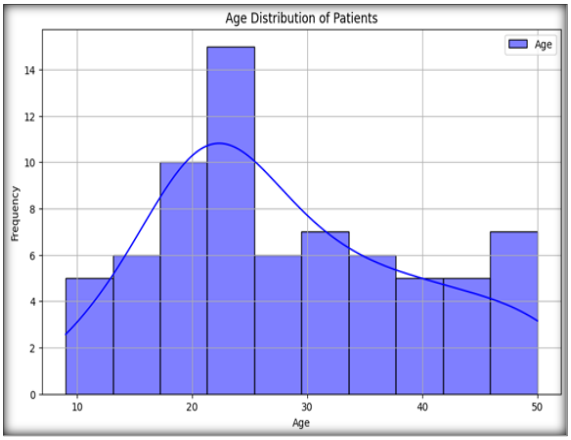

Figure 1: Distribution of age group of Participants

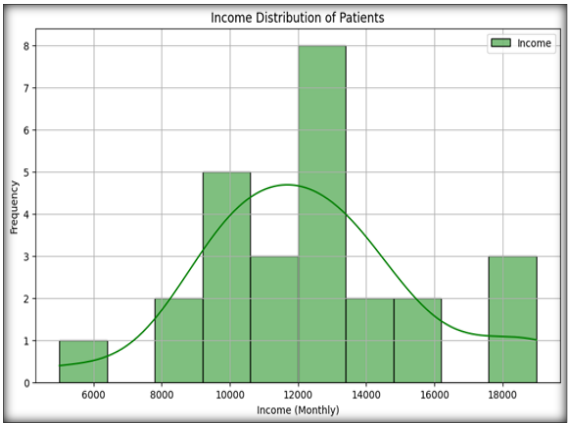

Figure 2: Distribution of Income of Participants

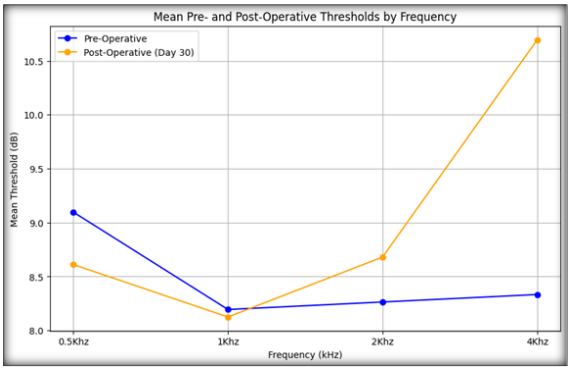

Figure 3: Graphical presentation of mean of preoperative and postoperative thresholds with frequency

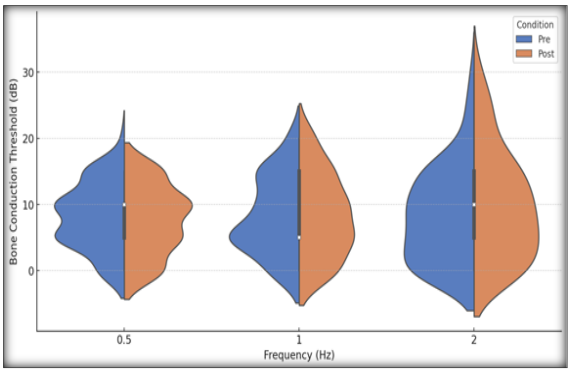

Figure 4: Distribution of Pre- and Post-Operative Bone Conduction Thresholds

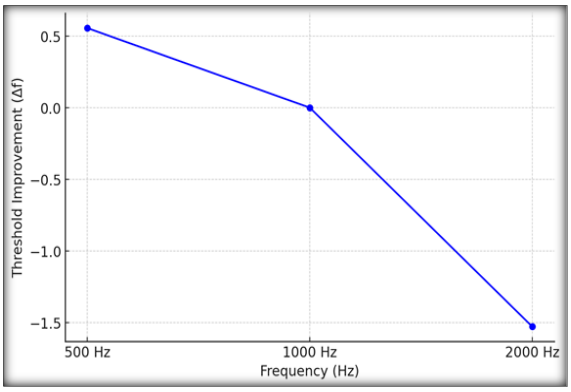

Figure 5: Interaction Plot: Change in Bone Conduction Thresholds

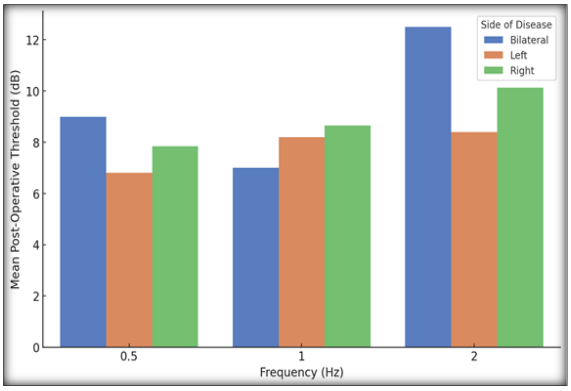

Figure 6: Mean Post-Operative Bone Conduction Thresholds across Frequencies and Disease Sides

DISCUSSION

The ear is a crucial part of the human communication system, because it allows us to hear. As a result, safeguarding the ears from potential harm is crucial; noise-induced hearing loss is just one such example. Despite its rarity, sensorineural hearing loss is a major risk factor in patients undergoing middle ear surgery. The otolaryngology department at MGM Medical College, Jamshedpur was the site of our 72-cohort study.

The World Health Organization (WHO) predicts that by 2050, the number of people with disabling hearing loss will exceed 900 million, constituting 6.1% of the global population.[9] In India, the incidence of adult-onset deafness is 7.6%.[10]

The age range of our patients, 9-50, was comparable to that reported by Mazhar et al. The CSOM among children in the age group 9-19 was 20%. According to a study of CSOM in this age group, it was almost the same.

According to Mazhar et al,[11] they did not note any sensorineural hearing loss was not observed. Patients underwent audiometric tests preoperatively and on the 30th postoperative day. Our patient underwent three types of surgeries: type 1 myringoplasty. Type 2 Tympanoplasty with Ossiculoplasty The third procedure is Type 3 Tympanoplasty with Mastoidectomy. No sensorineural hearing loss was observed after modified radical mastoidectomy or modified radical mastoidectomy with tympanoplasty types 2, 3, or 4.

Kumar et al,[12] did a study and found that there was no such thing as postoperative SNHL. They also found that there was no statistically significant difference between the preoperative bone conduction threshold values and the postoperative values. One possible explanation for the absence of a statistically significant shift in bone conduction thresholds is that the suction and drill noise levels were too high. This might merely cause a short-lived change in threshold and provide the sensory cells time to recuperate without seriously damaging their structure.

We found that the mean bone conduction threshold for frequencies before and after surgery (day 60) corresponded. The lack of changes at 500 Hz and 1000 Hz suggests that the effects are frequency-specific. However, at 2000 Hz, surgical intervention greatly enhanced bone conduction thresholds ($p = 0.007$). We suggest plotting the data for the preoperative and postoperative hearing thresholds in a diagram. This diagram representation helps identify individual patients and better interpret the results (Figure 05). García-Iza et al,[13] also discovered a significant improvement in the bone conduction threshold at frequencies of 1000 and 2000 Hz.

The interaction plot showed changes in bone conductance thresholds (Figure 06). Multiple assessments While There was no significant

difference in overall improvements across frequencies ($p = 0.002$), and there was a significant interaction between pre- and post-operative conditions and frequency ($p = 0.002$), indicating that the frequency had varied impacts on the success of the surgery. Fang et al,[14] noted that there was no change in the frequency of pre- and post-operative bone conduction thresholds.

According to the ANOVA, the only factor that did not change significantly was the direction of the post-operative results. The study examined the average post-operative bone conduction thresholds across frequencies and disease sides. This means that the procedure worked for all patient groups, regardless of whether the disease side was right, left, or bilateral. More research is needed on the therapeutic effects of frequency-dependent improvements, since these results show that surgical outcomes are usually good, but the benefits are most noticeable at higher frequencies.

CONCLUSION

The study found no significant shift in the threshold values for bone conduction despite the noise from drilling and suction. If a temporary shift occurs, it usually recovers within three months. The correct technique and instruments during surgery can help avoid post-operative sensorineural hearing loss. The duration of ear discharge, duration of surgery, and type of surgery did not affect post-operative sensory neural hearing levels. Otology clinics should identify and discuss patients experiencing post-operative sensorineural hearing loss and review their surgical video recordings to determine the cause. Proper evaluation is necessary for patients with deteriorating hearing following middle ear surgery, as slow progression, late consultation delays, and under-reporting can obscure its true representation and treatment. Audiometry is a simple, reliable, and safe method to determine post-operative SNHL. Due to its unpredictable outcomes, middle ear surgery is challenging for surgeons, so obtaining thorough informed consent and providing adequate pre-operative counselling is crucial.

Limitation

Our study has some limitations. We conducted our study in a hospital setting, with a relatively small sample size. When obtaining pre-operative consent, surgeons should emphasize the risk of SNHL and perform all osteotomies carefully to avoid complications. However, no evidence of postoperative hearing loss was found in our study. We suggest examining the effect of various factors on postoperative hearing as a potential area for future research.

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All authors: Dr Sanjay Kumar, Dr Rajan Kumar Barnwal, Dr Bhim Sen Hansdah, and Kumar Vimal. Dr Vikas Kumar Sharma. conceptualised, designed, supervised, and resourced literature search and writing of the study.

Dr Rajan Kumar Barnwal & Kumar Vimal performed the statistical analysis and interpretation of data.

Kuber Chandra Setua helped draft the laboratory protocols and reporting. Manish Kumar performed the data entry.

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