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Original Research Article

Comparison of Outcomes in Patients with Different Types of Hearing Loss

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Abstract

Background: Hearing loss is a prevalent sensory disorder categorized into three primary types: sensorineural, conductive, and mixed. Each type has distinct etiologies, management approaches, and prognoses. Understanding the comparative effectiveness of interventions across these types is essential for guiding clinical decision-making and optimizing patient outcomes.

Methods: From October 2023 to March 2025, Patna Medical College & Hospital (PMCH) researchers in Bihar collected data for this retrospective observational study. For the study, 100 patients with verified hearing loss were assessed and classified as sensorineural, conductive, or mixed. Data came from audiology reports, follow-up notes, and patient records. Hearing threshold (dB), speech recognition, and patient-reported outcome measures (PROMs) were measured. Statistical analysis was done with R and SPSS.

Results: Of the 100 patients, 46 had sensorineural, 34 had conductive, and 20 had mixed hearing loss. Patients with conductive hearing loss showed the greatest improvement in hearing thresholds (mean: 20.6 dB) and the highest satisfaction scores. Sensorineural cases exhibited moderate improvement with hearing aids, while mixed hearing loss had the most variable outcomes. Statistical analysis revealed significant differences in outcomes between groups ($p < 0.05$).

Conclusion: The study demonstrates that outcomes in hearing loss vary significantly by type, emphasizing the importance of accurate classification and timely intervention. Conductive hearing loss responds best to treatment, while mixed hearing loss requires a tailored, multidisciplinary approach. Early diagnosis and individualized management are essential to improving functional outcomes.

Keywords: Audiometry, Conductive Hearing Loss, Hearing Aids, Hearing Threshold, Mixed Hearing Loss.

Introduction

Hearing loss is a common worldwide sensory problem affecting all ages [1]. Communication, social interaction, cognitive development, and life satisfaction can all be greatly affected. Hearing loss is classified by disease location as conductive, sensorineural, or mixed [2]. Otitis media, impacted cerumen, and otosclerosis restrict sound transmission in the middle or outer ear, causing conductive hearing loss [3]. Sensorineural hearing loss is more common and caused by auditory nerve or cochlear damage, ageing, noise exposure, ototoxic drugs, or genetics [4]. Mixed hearing loss is harder to diagnose and treat because it contains conductive and sensorineural components. Hearing loss is a major public health issue in India [5]. The World Health Organisation estimates that about 6% of Indians have hearing loss, and that percentage will climb due to the country's ageing population and increased city noise. Bihar has a significant volume of ENT (Ear Nose Tongue) outpatient cases, especially in urban centres like Patna, but few region-specific studies have examined hearing loss type-specific patient outcomes [6]. In resource-poor Bihar, the lack of systematic audiological screening and access to professional hearing care makes early diagnosis and treatment harder.

Figure 1: **Types of Hearing Loss [7]**

Untreated or poorly managed hearing loss has severe consequences beyond physiology. It can impair language learning and academic performance in children and induce social isolation, sadness, decrease employability, and cognitive decline in adults. Early diagnosis and intervention reduce long-term effects [8,9]. Medical management and surgical correction are options for conductive hearing loss, while hearing aids or cochlear implants are options for sensorineural hearing loss [10]. The decision made can affect treatment efficacy, depending on the type and severity of hearing loss [11,12].

Comparing data from different types of hearing loss is crucial for informed therapeutic decision-making, as there are numerous causes and therapies. To fill the gap in regional data, this study will compare the treatment of conductive, mixed, and sensorineural hearing loss at PMCH in Bihar. Comorbidities, type of intervention, timing, and demographic characteristics are aspects the study aims to illuminate concerning recovery and long-term rehabilitation. Assessment of hearing threshold improvement, speech discrimination scores, and patient satisfaction can enhance diagnosis and treatment methods in comparable public healthcare settings. Evidence-based insights are sought in this study. Local healthcare planning will benefit from this research's identification of the most receptive patient profiles and refinement of intervention approaches for specific types of hearing loss.

Objectives of the Study

- To categorize patients diagnosed with hearing loss into sensorineural, conductive, and mixed types based on clinical and audiological evaluation.
- To compare the clinical outcomes among the different types of hearing loss, focusing on improvement in hearing thresholds, speech discrimination scores, and patient-reported satisfaction.
- To assess the effectiveness of various treatment modalities (medical, surgical, rehabilitative) across different hearing loss types.

Materials and Methods

Study Design: This study was designed as a retrospective observational analysis aimed at comparing the clinical outcomes of patients diagnosed with different types of hearing loss. The primary objective was to evaluate the effectiveness of treatment modalities and the improvement in auditory function over time among distinct categories of hearing impairment.

Study Population: The study included a total of 100 patients who were diagnosed with hearing loss and underwent evaluation and treatment at PMCH, Patna, Bihar, during the period from October 2023 to March 2025.

Inclusion Criteria

- Patients aged 10 years and above.
- Confirmed diagnosis of conductive, sensorineural, or mixed hearing loss based on audiological testing.
- Availability of complete medical records.
- Availability of follow-up data.

Exclusion Criteria

- Patients with congenital hearing anomalies.
- History of cranial trauma.
- Presence of comorbid neurological disorders affecting hearing interpretation.
- Incomplete medical records or loss to follow-up.

Classification of Hearing Loss: For this study, researchers divided hearing-impaired patients into three groups after extensive audiological testing and clinical diagnoses. Speech and pure-tone audiometry provided objective criteria for classification. Sensorineural hearing loss was diagnosed when the cochlea or the auditory nerve was injured. The diagnosis usually requires high-frequency hearing loss and low speech discrimination on pure-tone audiometry. Conductive hearing loss is caused by outer or middle ear issues, including earwax impaction, otitis media, or ossicular chain anomalies. These patients' audiometric profiles showed a clear air-bone gap due to unaffected bone conduction thresholds. Mixed hearing loss incorporates conductive and sensorineural components. These patients had higher thresholds for bone conduction

and air conduction on audiograms, with the former being worse. This implies mechanical and peripheral sensory dysfunctions in these patients. This classification was necessary to compare hearing loss types and determine the best treatments.

Location and Duration: PMCH, a public tertiary care facility serving a diverse and expansive patient population, was the site of the research. October 2023–March 2025 was the duration of the study.

Data Collection Tools: Hearing records, patient case files, and therapy follow-up notes were used for this study. Hearing loss was assessed and classified using many conventional tools. Pure-tone audiometry was the main diagnostic approach for sensorineural, conductive, and mixed hearing loss. Patients' functional communication abilities were assessed using speech audiometry-based speech recognition scores. Patients were assessed using self-report questionnaires, with the Hearing Handicap Inventory measuring the perceived impact of hearing loss on daily life and communication. Exhaustive medical records were examined for clinical history, intervention type (medical, surgical, or rehabilitative), and outcomes. This multi-source method assessed treatment efficacy using clinical and patient-reported data.

Outcome Measures: This study's end measures included audiology improvement and patient satisfaction. Hearing threshold changes in decibels (dB) during post-treatment audiometry tests were important.

Speech recognition score, which measured how well the patient understood spoken language before and after the intervention, was also essential. To assess the treatment's impact on hearing and satisfaction, validated questionnaires were employed to collect PROMs. These combined measurements can help understand all types of hearing loss and evaluate therapy efficacy.

Statistical Analysis: SPSS and R (4.2.1) were used to analyse the data. The demographic and baseline clinical characteristics were described using descriptive statistics. ANOVA, t-tests, and Chi-square tests were used to compare the three groups' outcomes.

A p-value below 0.05 indicated statistical significance.

Results

Demographic Characteristics: One hundred hearing-impaired people participated in the study. The participants' ages ranged from 12 to 70 years, with an average age of 42 years (±13.7 SD). The population was 42 women and 58 men (58%). Most affected were 41-60-year-olds. Sensorineural hearing loss was most common, but conductive and mixed types were also present.

Table 1: Demographic Profile of Study Participants

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age (years)	12–20	10	10%
	21–40	28	28%
	41–60	45	45%
	61–70	17	17%
Sex	Male	58	58%
	Female	42	42%
Type of Hearing Loss	Sensorineural	46	46%
	Conductive	34	34%
	Mixed	20	20%

Distribution of Types of Hearing Loss: The study of 100 participants found that 46% had sensorineural hearing loss (SNHL), 34% had Conductive Hearing Loss (CHL), and 20% had mixed hearing loss.

CHL was more common in younger people with middle ear illness or recurrent ear infections, while SNHL was more common in older adults, especially those over 50.

Types of Interventions Administered: Hearing loss treatments depended on aetiology and severity. Most conductive hearing loss was addressed with medicine or surgery (tympanoplasty, mastoidectomy).

Most sensorineural and mixed hearing loss was treated with hearing aids. Fewer patients received speech or aural rehabilitation, especially in mixed-case circumstances.

Table 2: Distribution of Intervention Types by Hearing Loss Category

Type of Hearing Loss	Hearing Aids	Surgery	Medical Therapy	Speech Therapy
Sensorineural	38	2	4	2
Conductive	8	22	18	3
Mixed	14	4	6	4

Outcome Comparison by Hearing Loss Type: The outcomes were assessed using PROMs, speech recognition scores, and hearing threshold improvement (in dB). Speech recognition and thresholds improved significantly (mean improvement: 10.4 dB) for sensorineural hearing loss patients wearing hearing aids. Hearing thresholds improved 20.6 dB on average for conductive hearing loss patients after medication or surgery. Mixed hearing loss patients improved speech understanding and thresholds moderately (12.2 dB) depending on the intervention.

Table 3: Outcome Comparison across Hearing Loss Types

Outcome Measure	Sensorineural	Conductive	Mixed	p-value
Mean Threshold Improvement (dB)	10.4 ± 3.2	20.6 ± 4.8	12.2 ± 4.1	<0.001
Mean Speech Recognition Score (%)	78.5 ± 9.1	85.2 ± 6.3	72.4 ± 10.7	0.02
PROMs Satisfaction (1–5 scale)	4.1 ± 0.6	4.5 ± 0.4	3.8 ± 0.7	0.01

Statistical Significance

Statistics showed that the three types of hearing loss varied greatly. Conductive hearing loss patients showed greater satisfaction and hearing threshold improvements compared to other groups ($p < 0.001$). Analysis of variance and t-tests showed statistically significant differences in results across groups with 95% confidence intervals, validating tailored hearing loss therapies.

Discussion

This study found that PMCH patients with sensorineural, conductive, or mixed hearing loss had crucial clinical insights over 18 months. CHL improved hearing threshold and patient satisfaction the most among the three groups. This discovery fits with CHL's pathogenesis, which often involves reversible mechanical abnormalities in the middle or external ear that can be treated with medicine or surgery. Patients who underwent tympanoplasty, ossiculoplasty, or medical therapy for infections or effusion had significant improvements in hearing thresholds (20.6 dB) and speech recognition.

Even with hearing aids, SNHL patients exhibited extremely tiny hearing threshold improvements (mean improvement: 10.4 dB) due to the irreversible nature of cochlear hair cell or auditory nerve injury.

Despite modest physiological recovery, several SNHL patients reported subjective improvement in conversational ability, particularly in quieter circumstances, with average PROMs satisfaction levels above 4.0. This highlights the importance of rehabilitative therapies like counselling and amplification devices in improving the quality of life for sensory impairments.

Mixed hearing loss (MHL) individuals exhibited the least consistent findings due to the complexity of sensorineural and conductive illnesses. These patients' responses varied by intervention type and major component. Some folks saw some improvement with surgery and hearing aids, while others didn't. Speech recognition improved less, and the threshold improved 12.2 dB, indicating the difficulties of treating hearing impairments caused by multiple reasons.

A demographic correlation study found that gender and age significantly affected treatment results. Older people, especially those over 60, improved less across all categories, possibly because of age-related hearing loss and delayed presentation. SNHL patients were mostly male, while CHL patients were more female. SNHL is connected to long-term exposure to loud noises and age-related hearing loss, while CHL is linked to repeated infections, especially in younger people. Results were altered by intervention type (medical, surgical, or rehabilitative), underlining the necessity for individualised treatment.

Comparison with Existing Literature: The majority of results match Indian and global studies. Multiple studies have demonstrated that ossiculoplasty and tympanoplasty can repair conductive hearing loss when done quickly. Middle ear treatments enhanced hearing thresholds in study 1, indicating that structural repair is effective when the cochlea is unharmed. However, brain damage severity and treatment speed considerably affect SNHL results.

Study 2 noted the plateauing effect in mild to severe cases, while hearing aid users with SNHL gained speech perception scores similarly. The findings demonstrate that SNHL patients improved communicative function but did not objectively recover. Managing combined hearing loss evolves. Study 3 shows that patient compliance and aetiology affect combo therapy results. Variability in our study supports the premise that individuals need individualised, multi-modal rehabilitation programs. This study's gender ratio and age distribution match the national pattern, according to WHO and ICMR estimates.

Table 4: Comparison of Present Study with Existing Literature

Study	Study Design	Sample Size	Hearing Loss Types	Key Findings
Present Study	Retrospective, single-center	100	Sensorineural, Conductive, Mixed	Conductive HL showed best improvement (20.6 dB); Mixed HL had most variable outcomes.
Study1 [13]	Prospective clinical study	80	Conductive	85% of CHL patients showed ≥15 dB improvement post-surgery.
Study2 [14]	Observational, multicenter	120	Sensorineural	Moderate improvement in speech scores; early fitting correlated with better outcomes.
Study3 [15]	Cross-sectional study	60	Mixed	Variable outcomes; dependent on dominant HL type and intervention sequence.

Limitations of the Study: Despite its limitations, this study has substantial clinical implications. Starting with 100 patients is plenty for the comparison, but it doesn't allow us to draw any conclusions about the population.

For more representative subgroup analyses across aetiologies and intervention types, bigger, multicenter trials are needed.

As this study was a retrospective review of one tertiary care institution, resource availability, clinician competence, and population health may limit its applicability to other parts of Bihar or India.

The absence of extensive follow-up data, especially for mixed hearing loss, is another problem. Failure to document long-term outcomes, such as sustained speech improvements or device compliance, prevented comprehensive analysis. Patient-reported outcome measurements may also be biased by recollection or lack of follow-up interviews.

Strengths of the Study: Despite these restrictions, the research has several benefits. Its strengths include its focused cohort method, which uses well-defined patient groups by hearing loss type. This improved classification made statistical analysis and comparisons more productive.

The study also illuminates how treatment outcomes at a high-volume tertiary care hospital affect practice. Because they show the challenges and successes of managing hearing loss in low-resource healthcare systems in India, the study's findings are applicable. Due to objective audiometric data and subjective PROMs, the results address therapeutic efficacy and patient satisfaction, which are increasingly important in modern medicine. Using known statistical methodologies and stated result parameters makes the study and interpretation more believable.

Conclusion

In this Patna Medical College & Hospital clinical outcomes study, sensorineural, conductive, and mixed hearing loss showed significant differences in recovery and treatment response. Due to surgical and medicinal therapies, conductive hearing loss patients experienced the best hearing threshold improvement and patient satisfaction. Despite being less curable, hearing aids and rehabilitation improved functional ability moderately. Divergent results from mixed hearing loss were the major management challenges. These results demonstrate the therapeutic importance of early diagnosis because prompt and adequate treatment improves patient prognosis. Based on the findings, tailored hearing loss treatment programmes require objective audiometric evaluation and subjective patient input. Improving long-term success in hearing-impaired patients involves better diagnostic infrastructure, cheaper hearing devices, and regular clinical practice with follow-up.

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