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RELATIONSHIP BETWEEN TINNITUS SEVERITY AND AUDIOLOGICAL CHARACTERISTICS IN ADULTS WITH STIFFNESS-INDUCED CONDUCTIVE HEARING LOSS

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ABSTRACT:
Background: Tinnitus may occur in association with conductive hearing disorders and altered middle-ear mechanics. Acoustic reflex testing provides an additional objective measure of middle-ear and stapedius muscle function.
Objective: To compare the presence of acoustic reflexes in adults with subjective tinnitus and stiffness-induced conductive hearing loss with adults having normal hearing sensitivity and no tinnitus.
Methods: A cross-sectional comparative study included 100 adults aged 25–70 years: 50 participants with subjective tinnitus and stiffness-induced conductive hearing loss and 50 controls with normal hearing sensitivity and no tinnitus. Participants underwent pure-tone audiometry, tympanometry, and acoustic reflex assessment. In the case group, tinnitus-related handicap was assessed using the Tinnitus Handicap Inventory. Categorical between-group differences in acoustic-reflex presence were assessed using Pearson's chi-square test.
Results: Both groups contained 25 males and 25 females. Acoustic reflexes were present in 28/50 (56%) cases and 45/50 (90%) controls, while absent in 22/50 (44%) and 5/50 (10%), respectively. The between-group difference was statistically significant ($\chi^2 = 14.66$, df = 1, $p = 0.0001$). In the case group, hearing-loss severity comprised 15 (30%) mild, 30 (60%) moderate, and 5 (10%) moderately severe cases.
Conclusion: Adults with tinnitus and stiffness-induced conductive hearing loss showed a lower proportion of measurable acoustic reflexes than controls with normal hearing sensitivity and no tinnitus. Acoustic reflex assessment may provide useful complementary information during audiological evaluation of this clinical population.

KEYWORDS: tinnitus; conductive hearing loss; middle-ear stiffness; acoustic reflex; tympanometry; pure-tone audiometry; Tinnitus Handicap Inventory

INTRODUCTION

Tinnitus is the perception of sound in the absence of an external acoustic stimulus. It may be associated with hearing impairment, emotional distress, sleep disturbance, reduced concentration, and limitations in daily functioning. The clinical characteristics of tinnitus vary according to the underlying auditory and otologic condition.

Much of the tinnitus literature concerns sensorineural hearing loss, whereas tinnitus associated with stiffness-related conductive hearing loss has received comparatively less attention. Disorders affecting middle-ear mechanics can reduce sound transmission and alter the auditory input reaching the central auditory system. These changes may coexist with tinnitus and may influence the findings obtained during immittance-based assessment.

Acoustic reflex testing measures changes in middle-ear immittance associated with contraction of the stapedius muscle in response to an acoustic stimulus. When interpreted together with pure-tone audiometry and tympanometry, acoustic reflex findings can provide additional information about middle-ear and auditory pathway function.

The present cross-sectional comparative study was designed to compare acoustic-reflex presence between adults with subjective tinnitus and stiffness-induced conductive hearing loss and adults with normal hearing sensitivity and no tinnitus.

OBJECTIVE

To compare the presence or absence of acoustic reflexes between adults with subjective tinnitus and stiffness-induced conductive hearing loss and controls with normal hearing sensitivity and no tinnitus.

MATERIALS AND METHODS

Study Design

A cross-sectional comparative study was conducted in a tertiary-care audiology setting. The study included 100 adults divided into a case group (n = 50) and a control group (n = 50).

Participants

The case group comprised 50 adults aged 25–70 years with subjective tinnitus and stiffness-induced conductive hearing loss. The control group comprised 50 adults aged 25–70 years with normal hearing sensitivity and no tinnitus. Each group included 25 males and 25 females.

Inclusion Criteria: Case Group

- Age 25–70 years.
- Subjective tinnitus.
- Air–bone gap on pure-tone audiometry consistent with conductive hearing loss.
- Middle-ear findings consistent with stiffness.
- Written informed consent.

Inclusion Criteria: Control Group

- Age 25–70 years.
- Normal hearing sensitivity on pure-tone audiometry.
- No tinnitus.
- No known conductive hearing loss.
- Written informed consent.

Exclusion Criteria

- Pulsatile tinnitus.
- Sensorineural hearing loss in the case definition.
- Mixed hearing loss.
- Known neurological disorder that could affect reliable audiological assessment.
- Previous tinnitus therapy, where applicable to the case-group assessment.

Audiological Assessment

Pure-tone audiometry was performed to establish hearing sensitivity and identify the air–bone gap. Tympanometry was used to assess middle-ear function. Hearing-loss severity in the case group was categorized as mild, moderate, or moderately severe according to the study classification. Acoustic reflex assessment was performed as an objective measure of middle-ear and stapedius muscle function, and findings were recorded as present or absent.

Tinnitus Assessment

The Tinnitus Handicap Inventory (THI) was used as a tinnitus-related outcome measure in the case group. The THI total score ranges from 0 to 100 and quantifies perceived tinnitus-related handicap.

Statistical Analysis

Data were analyzed using SPSS. Categorical variables were summarized as frequencies and percentages. Pearson's chi-square test was used to compare the distribution of acoustic-reflex presence and absence between the case and control groups. Statistical significance was set at $p < 0.05$.

RESULTS

Participant Characteristics

The case group included 50 participants with a mean age of 38.6 ± 10.4 years; 25 (50%) were male and 25 (50%) were female. The control group included 50 participants aged 25–70 years, with 25 (50%) males and 25 (50%) females. All controls had normal hearing sensitivity and no tinnitus. Figure 1 illustrates the between-group distribution of reflex presence and absence.

Table 1. Demographic and hearing characteristics of the study groups. Age was not statistically compared because a control-group mean ± SD was not available.

Variable	Case group (n=50)	Control group (n=50)	P value
Age	38.6 ± 10.4 years	25–70 years	—

Male	25 (50%)	25 (50%)	1.000
Female	25 (50%)	25 (50%)	1.000
Hearing status	Stiffness-induced conductive hearing loss	Normal hearing sensitivity	—

Hearing-Loss Severity in the Case Group

Table 2. Distribution of hearing-loss severity in the case group.

Severity	Case group, n (%)
Mild	15 (30%)
Moderate	30 (60%)
Moderately severe	5 (10%)
Total	50 (100%)

Acoustic Reflex Findings

Table 3. Acoustic reflex findings in the two study groups. Pearson's chi-square test demonstrated a statistically significant difference in reflex presence between groups ($\chi^2 = 14.66$, df = 1, p = 0.0001).

Reflex finding	Case group (n=50)	Control group (n=50)	χ^2	P value
Reflex present	28 (56%)	45 (90%)	14.66	0.0001
Reflex absent	22 (44%)	5 (10%)	—	—

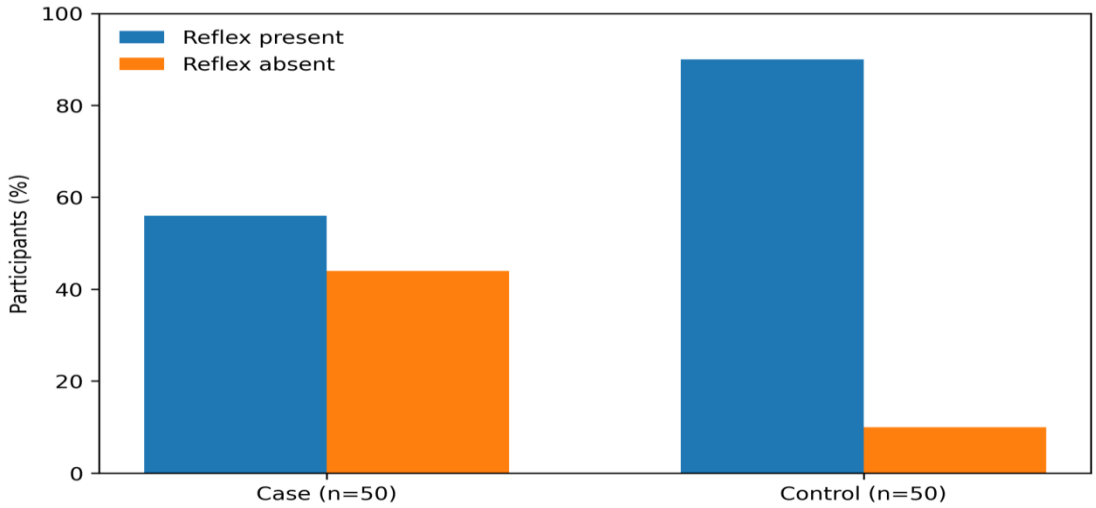

Figure 1. Distribution of acoustic reflex findings in the case and control groups. Reflex was present in 56% of cases and 90% of controls, while absent in 44% and 10%, respectively.

DISCUSSION

The present cross-sectional comparative study demonstrated a significant difference in acoustic-reflex findings between adults with tinnitus and stiffness-induced conductive hearing loss and controls with normal hearing sensitivity and no tinnitus. A measurable reflex was present in 56% of the case group compared with 90% of the control group.

The lower proportion of measurable acoustic reflexes in the case group is clinically plausible in the context of altered middle-ear mechanics. Conductive components and reduced middle-ear mobility can influence immittance-based reflex measurements. Therefore, acoustic reflex assessment may provide complementary information when interpreted alongside pure-tone audiometry and tympanometry.

The case group showed a predominance of moderate conductive hearing loss, with 30 of 50 participants (60%) classified as moderate, followed by 15 (30%) mild and 5 (10%) moderately severe. This distribution provides clinical context for the observed acoustic-reflex findings.

The study should be interpreted as a cross-sectional comparison. Because the design does not include an intervention or longitudinal follow-up, the observed association between group status and acoustic-reflex presence should not be interpreted as evidence of causality or treatment effect.

LIMITATIONS

• The study used a cross-sectional design and therefore cannot establish causal relationships.
• The available dataset did not include control-group mean ± SD age, so a between-group age comparison was not performed.
• The present analysis used reflex presence/absence rather than detailed reflex-threshold measurements.
• The case group was defined by tinnitus with stiffness-induced conductive hearing loss, which may limit generalizability to other tinnitus populations.

CONCLUSION

Adults with subjective tinnitus and stiffness-induced conductive hearing loss demonstrated a significantly lower proportion of measurable acoustic reflexes than controls with normal hearing sensitivity and no tinnitus. Acoustic reflex assessment may be a useful complementary component of the audiological evaluation of patients with middle-ear stiffness and tinnitus. Larger studies incorporating detailed acoustic-reflex thresholds and additional clinical variables are warranted.

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AUTHOR CONTRIBUTIONS

Mayank Mehra: Conceptualization, data collection, audiological assessment, formal analysis, and manuscript drafting. Vivek Kumar Jha: Methodology, supervision, and manuscript review and editing. Omprakash Preyadarshi and Pawan Kumar: Clinical/audiological support and manuscript review. All authors approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

Written informed consent was obtained from all participants before participation. The study was conducted in accordance with applicable institutional ethical requirements.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author on reasonable request, subject to institutional requirements.

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