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# Analysis and Reflection on a Case of Diagnosis and Identification of Occupational Noise-induced Deafness

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**Abstract:** O*bjective*: Through retrospective analysis of a case of occupational noise-induced hearing loss (NIHL) diagnosis and two-grade appraisal, this study explores the causes of inconsistency between diagnosis and appraisal conclusions, aiming to improve occupational health management. *Methods*: Data including occupational history, workplace noise exposure levels, pure-tone audiometry (PTA), and objective audiological tests were collected and analyzed. *Results*: Both municipal and provincial appraisals contradicted the initial diagnostic conclusion of "moderate occupational NIHL". *Conclusion*: The diagnosis of occupational NIHL requires multidisciplinary expertise and is influenced by subjective factors. Appraisal institutions should adopt evidence-based approaches, integrate objective tests with PTA results, and comprehensively evaluate occupational exposure history to ensure scientific and impartial conclusions.

**Keywords:** Occupational noise-induced hearing loss; Occupational disease diagnosis; Occupational disease appraisal; Evidence-based medicine

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## 1. Introduction

Occupational noise-induced deafness is the second most common occupational disease in China. Its diagnosis and appraisal involve multiple disciplines such as medicine and occupational health, and are susceptible to subjective factors. This article analyzes the underlying reasons for differences in conclusions through a controversial case of diagnosis and appraisal of a factory vehicle driver, aiming to provide a basis for standardizing the diagnostic process of occupational noise-induced deafness and improving the consistency of appraisal.

## 2. Case information

### 2.1. Occupational history

Male, 54 years old, worked as a factory vehicle driver from May 2008 to September 2021, with an average daily noise exposure of 7 hours (6 days per week). He wore earplugs during work.

## 2.2. Noise exposure level

The noise intensity in the workplace from 2018 to 2021 ranged from 78.6 to 91.1 dB(A) (L~ex, 8h~).

## 2.3. Hearing examination

### 2.3.1. In-service physical examination

In 2013, the speech frequency hearing threshold of the right ear was significantly abnormal (81 dB). In 2015, there was high-frequency hearing loss in the right ear, but the results from 2017 to 2020 were normal.

### 2.3.2. Examination during diagnosis (2021)

Multiple pure tone audiometry tests showed total deafness in the right ear and sensorineural hearing loss in the left ear, but the repeatability of the results was poor (**Table 1**).

**Table 1.** Summary of hearing examination results

| Test date | Type | Left ear (dB HL) | | | | | | Right ear (dB HL) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 Hz | 1 kHz | 2 kHz | 3 kHz | 4 kHz | 6 kHz | 500 Hz | 1 kHz | 2 kHz | 3 kHz | 4 kHz | 6 kHz |
| Aug 30, 2013 | AC | 32 | 32 | 30 | 27 | 43 | 42 | 82 | 82 | 80 | 77 | 88 | 77 |
| Nov 9, 2015 | AC | 18 | 18 | 17 | 39 | 57 | 41 | 83 | 73 | 77 | 89 | 92 | 91 |
| Jul 6, 2017 | AC | 18 | 23 | 22 | 19 | 17 | 16 | 18 | 18 | 17 | 14 | 12 | 11 |
| Jul 8, 2019 | AC | 21 | 21 | 13 | 13 | 19 | 27 | 21 | 16 | 18 | 13 | 9 | 12 |
| Sep 16, 2020 | AC | 21 | 21 | 18 | 13 | 9 | 7 | 21 | 16 | 13 | 13 | 9 | 7 |
| Aug 31, 2021 | AC | 86 | 91 | 93 | 93 | 84 | 87 | 91 | 91 | 93 | 108 | 104 | 92 |
| | BC | 41 | 51 | 63 | 58 | 49 | 32 | 46 | 56 | 68 | 68 | 59 | 32 |
| Oct 18, 2021 | AC | 46 | 46 | 28 | 58 | 64 | 52 | 96 | 101 | 83 | 108 | 104 | 92 |
| | BC | 26 | 46 | 53 | 53 | 54 | 32 | 36 | 61 | 63 | 68 | 59 | 32 |
| Oct 22, 2021 | AC | 41 | 51 | 53 | 73 | 74 | 72 | 101 | 101 | 88 | 108 | 104 | 92 |
| | BC | 46 | 56 | 58 | 68 | 59 | 32 | 61 | 56 | 58 | 63 | 59 | 32 |
| Oct 26, 2021 | AC | 56 | 51 | 48 | 68 | 79 | 77 | 111 | 106 | 93 | 108 | 104 | 92 |
| | BC | 61 | 61 | 63 | 68 | 59 | 22 | 61 | 71 | 73 | 68 | 59 | 32 |

Notes: The pure tone audiometric test results from the diagnostic institution were obtained on October 18, 22, and 26, 2021.

## 2.4. Objective examinations (November 1, 2021)

(1) Auditory brainstem response (ABR): No V wave was elicited in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL.

(2) 40Hz auditory event-related potential: No V wave was elicited in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL.

(3) Acoustic impedance: Both ears showed type A tympanograms.

(4) Otoacoustic emissions: Both ears failed the DPOAE and TEOAE tests.

## 3. Occupational disease diagnosis

The diagnostic team unanimously agreed that the worker had a clear history of exposure to occupational noise. The results of the three electro-audiometric tests after applying for diagnosis were relatively repeatable. The right ear showed air-bone conduction separation, indicating mixed hearing loss, but the bone conduction was consistent with the characteristics of occupational noise-induced deafness. After calculating the minimum threshold value for each frequency of the bone conduction results from the three tests and adjusting for age, the weighted hearing threshold for the right ear was 51 dB. The left ear showed sensorineural hearing loss, and after calculating the minimum threshold value for each frequency of the three test results, the weighted hearing threshold for the left ear was 41 dB. Objective hearing tests showed that the auditory brainstem response did not elicit a V wave in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL. The 40Hz auditory event-related potential also did not elicit a V wave in the right ear with 100 dBnHL sound intensity stimulation, and the V wave reaction threshold in the left ear was 60 dBnHL. Acoustic impedance tests showed type A tympanograms for both ears. Otoacoustic emissions tests (DPOAE and TEOAE) were not passed in both ears. The worker denied a family history of genetic deafness and also denied other causes of deafness, such as infection, trauma, or medication. Based on GBZ 49-2014 “Diagnosis of Occupational Noise-Induced Deafness,” the diagnosis on December 13, 2021, was “Occupational moderate noise-induced deafness.”

## 4. Occupational disease identification

### 4.1. Municipal-level identification

The enterprise disagreed with the diagnosis of “occupational moderate noise-induced deafness” and requested an occupational disease identification on January 10, 2022.

#### 4.1.1. Consensus opinion

Four identification experts believed that the worker had a history of occupational noise exposure. Abnormalities related to occupational hazard factors were found in occupational health checks in 2013 and 2015, while audiometric tests were normal in 2017 and 2019. However, in 2021, the audiometric test showed abnormalities. The expert group pointed out the poor repeatability of audiometric results and contradictions between subjective and objective tests. Additionally, the hearing loss did not conform to the progressive characteristics of noise-induced deafness. Based on the GBZ49-2014 “Diagnosis of Occupational Noise-Induced Deafness” standard, the identification conclusion was: no occupational noise-induced deafness.

#### 4.1.2. Dissenting opinion

One identification expert believed that, based on interviews with the worker at the identification meeting, he self-reported hearing loss accompanied by tinnitus. Two other workers in the same job position were diagnosed with

"occupational noise-induced deafness." The repeatability of the audiometric test results on October 18, 22, and 26, 2021, was acceptable. The right ear audiogram showed air-bone conduction separation, indicating mixed deafness, and the bone conduction matched the characteristics of occupational noise-induced deafness; the left ear showed sensorineural deafness. According to the GBZ49-2014 standard, when one ear has mixed deafness, and the bone conduction hearing threshold conforms to the characteristics of occupational noise-induced deafness, diagnosis and grading are based on the bone conduction hearing threshold of that ear. The worker's average high-frequency bone conduction hearing threshold for both ears was 48.8 dB, and the weighted hearing threshold for the right ear was 51 dB. Therefore, the diagnosis was: occupational moderate noise-induced deafness.

Following the principle that the identification conclusion should be approved by more than half of the identification committee members, the final municipal-level identification conclusion was: no occupational noise-induced deafness.

### 4.2. Provincial appraisal

The worker disagrees with the conclusion of the municipal appraisal and applies for a provincial appraisal to the Provincial Occupational Disease Diagnosis and Appraisal Committee. The expert group believes that the worker did not undergo pre-job occupational health checks and lacks pre-job baseline data. During employment, pure tone audiometry results were abnormal in 2013 and 2015, but normal from 2017 to 2020. However, the results were abnormal again in the post-employment occupational health check in 2021. Multiple pure tone audiometry tests from August 2021 to August 2022 showed total deafness in the right ear and sensorineural hearing loss in the left ear, but with poor reproducibility. On August 17, 2022, a 40Hz auditory evoked potential report from a hospital indicated specific hearing thresholds for both ears at different frequencies. No cases of occupational noise-induced deafness were found among employees of the same type of work. The worker has a history of occupational noise exposure. However, the inconsistent pure tone audiometry results during and after employment, as well as the poor reproducibility of subsequent tests, do not align with the characteristics of occupational noise-induced deafness. Therefore, the expert group concludes that the worker does not have occupational noise-induced deafness.

## 5. Discussion

The occupational disease diagnosis and appraisal system is a quasi-arbitration system that implements the inversion of the burden of proof, with medical knowledge as the background, combined with occupational health-related knowledge, and aimed at protecting the health rights and interests of workers and resolving liability disputes [1]. In this case, the diagnosis conclusion made by the occupational disease diagnosis institution was ultimately overturned by municipal and provincial appraisal institutions, indicating that there are certain differences in the analysis of data and attribution inference during the diagnosis process among diagnosis institutions. The worker, a factory driver, has been exposed to noise for more than 13 years without undergoing a pre-employment examination. Abnormalities related to occupational hazard factors were found in occupational health checkups in 2013 and 2015, while audiometric tests in occupational health checkups in 2017, 2019, and 2020 were normal. However, the audiometric test in the 2021 occupational health checkup showed abnormalities. The poor reproducibility of consecutive audiometric tests after the occupational disease diagnosis weakened the credibility of the diagnostic basis, and the hearing loss detected by audiometric tests did not conform to the pathogenic characteristics of gradual hearing loss caused by noise-induced deafness. Finally, the appraisal

conclusion was “no occupational noise-induced deafness.”

Due to the varying understanding of diagnostic criteria among different diagnosing physicians during the diagnostic process, and the possibility that some diagnosing physicians may lack relevant clinical practice experience and are not familiar with subjective and objective examination methods such as pure tone audiometry, acoustic impedance, auditory brainstem response, 40Hz auditory evoked potential test, otoacoustic emissions, and multifrequency steady-state, inconsistencies in opinions may easily arise. This can lead to misdiagnosis or missed diagnosis of occupational noise-induced deafness during the diagnosis and identification process [2–4]. It is recommended that occupational disease diagnosing physicians have a strict understanding of the audiological characteristics of conductive, sensorineural, and mixed hearing loss. Audiometric testing has a certain subjectivity, and its results are correlated with the cooperation of the subject, comorbidities, and the examiner’s experience. Therefore, it is necessary to reasonably apply objective examination results in the diagnostic process and cross-validate them with pure tone audiometry results to improve differential diagnosis ability [3]. At the same time, comprehensive consideration should be given in combination with occupational exposure history. Whether the noise detection value in the occupational hazard factor detection report can truly reflect the actual noise exposure situation of workers, so the impact of noise levels < 85dB on noise-exposed workers cannot be ignored during the diagnosis process [5].

The final diagnosis and appraisal conclusion of this case is “no occupational noise-induced deafness.” The employer bears certain faults: Firstly, the employer did not conduct pre-employment occupational health checkups on the patient according to law, and failed to promptly remove the worker from the noisy workplace and conduct further re-examination when abnormalities were found in the worker’s audiometric test results. Secondly, there was a lack of risk awareness and deficiencies in occupational health management, which led to difficulties in diagnosing this case. Therefore, as an employer, lessons should be learned, and pre-employment and on-the-job occupational health checkups should be standardized to facilitate early detection and early treatment, thereby better protecting workers’ occupational health.

The diagnosis of occupational noise-induced deafness requires consideration of both medical rigor and the correlation of occupational exposure. It is a highly specialized and subjective task that involves multiple disciplines and has high professional requirements for diagnostic physicians [6]. In this case, the phenomenon of two levels of appraisal overturning the diagnostic conclusion highlights the current deficiencies in standard implementation and multidisciplinary collaboration. In the future, efforts should be made to standardize the diagnostic process, strengthen objective evidence support, and urge employers to implement occupational health monitoring to achieve a balance between workers’ rights and corporate responsibilities.

## 6. Conclusion

The diagnosis of occupational noise-induced hearing loss (NIHL) should combine objective audiological tests with pure-tone audiometry (PTA) and a thorough assessment of occupational exposure history. A multidisciplinary, evidence-based approach is essential to minimize subjectivity and ensure scientifically sound, impartial conclusions.

## Disclosure statement

The author declares no conflict of interest.

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