Clinical and Audiological Characteristics of 1000 Hz Audiometric Notch Patients

Seung-kuk Shin, MD; Hyun-min Lee MD
Pusan National University Yangsan Hospital, Republic of Korea

ABSTRACT

Objective: There are specific frequency hearing losses such as c4-dip (2kHz loss) in otosclerosis and c5-dip (4kHz loss) in case of noise induced hearing loss. The c3-dip (1kHz loss), however, is seldom mentioned in clinical field. We found a group of patient with 1 kHz hearing loss fortuitously and report it with review of literature.

Methods: Tertiary academic referral center-based retrospective chart review and review of audiogram was done. Otologic history, audiogram, diagnosis, occupation, history of noise exposure were reviewed with chart and telephone interview. We compared the c3-dip group with 98 patients of c5-dip group (4kHz hearing loss group).

Result: Thirty one patients met the criteria of 1kHz audiometric notch. There are eleven males and 20 female with mean age of 40.6 years old. The pure tone threshold of 1kHz was 37.97 dB and the hearing threshold was 22.38 dB with other frequencies. Tinnitus was most the common complaints of c3-dip group compared with c5-dip group. The most common diagnoses of the c3-dip group were sudden sensorineural hearing loss (n=8) and idiopathic tinnitus (n=8). Female patients and unilateral cases were more common in c5-dip group than c3-dip group. Ear fullness was more common symptom in c3-dip group than c5-dip group. The duration of occupation-related noise exposure was longer in c5-dip group than c3-dip group. The history of head or ear trauma was more frequent in c3-dip group than c5-dip group.

Conclusion: We defined a new clinical entity of 1 kHz hearing loss group as c3-dip group. The c3-dip group showed different clinical and audiological features compared to c5 group. Further study would be needed to clarify this new entity of hearing loss group.

INTRODUCTION

Patients often exhibit notches at specific frequencies in standard pure tone audiometry (PTA). Some such examples are the Carhart notch, a notch at 2000 Hz in the bone-conduction audiogram of patients with otosclerosis, and the notch at 4000 Hz, which often presents in the case of noise-induced hearing loss. Since there has been no specific report of a notch at 1 000 Hz, our group investigated the clinical and audiological characteristics of patients who had this audiogram.ents often

METHODS AND MATERIALS

Our present study was retrospective and all data were gathered through phone interviews with patients. Of the 5 925 patients who underwent standard PTA examination at the first outpatient visit with the otolaryngologist from November 2008 to March 2015, 31 patients who showed a notch at 1.0 kHz (c3-dip group) were selected; additionally, 195 patients who showed a notch at 4.0 kHz were chosen as controls. To facilitate comparison, 98 of 195 patients who showed notches at 4.0 kHz and 124 ears were selected as a control group (c5-dip group) that considered age and gender. Each group was then subjected to analyses based on clinical information, hearing test results, and noise exposure history. Notches in audiograms were defined as cases where hearing threshold at the frequency showing a notch was ≥25.0 dB, hearing threshold at half the frequency was ≥15.0 dB, and hearing threshold at 2x higher frequency was ≥10.0 dB (Fig. 1).1 Test results were analysed using SPSS Statistics 18 (IBM, Armonk, NY, USA) statistical software. A p-value <0.05 with independent t-test and chi-square test was determined to be statistically significant.

RESULTS

Of the 5 925 patients who had standard PTA at first outpatient visit, there were 31 patients (0.52%) in the c3-dip group. In this group, there were 20 female (65%) and 11 male patients (35%). There were 17 right side cases, 13 left side cases, and 1 bilateral case. Mean patient age was 46.2 ± 14.53 years, with the highest proportion of patients between 50 and 59 years of age (Fig. 2 & Table 1).

The mean hearing level, which was determined using the 4 division method, at the side with a notch in the c3-dip group was 22.4 ± 8.19 dB, and the mean hearing threshold at 1000 kHz was 37.97 dB. For the opposite side, the mean hearing level was 26.1 ± 18.7 dB (Fig. 3).

The c3-dip group showed no statistically significant difference in hearing between male and female patients, or based on affected side and age (Fig. 4). The most frequent otologic symptom in the c3-dip group was ear fullness (Table 2). For hearing differences dependant on presence or absence of otologic symptoms, mean values at 1 000 Hz showed a statistically significant difference based on presence or absence of deafness; dizziness also resulted in a statistically significant difference in mean total hearing (Fig. 5).

History of noise exposure had a difference from the c5-dip group, whereas there was no statistically significant difference based on gender or presence or absence of exposure. (Fig. 5 & Table 2). Hearing threshold t-test had no correlation with age, symptom , and noise exposure time. Conversely, mean hearing threshold calculated by the 4 division method showed a positive correlation with hearing threshold at 1.0 kHz (R-squared = 0.77, p = 0.01) and duration of earphone use (R-squared = 0.37, p = 0.05).

When the c3-dip and c5-dip groups were compared, the c5-dip group had a significantly greater number of male patients (p < 0.000), and significantly higher mean age (49.9 years) than the c3-dip group. The c5-dip group had a significantly greater number of bilateral cases (n = 26, p = 0.005), whereas there were no significant differences in underlying diseases and eardrum findings between both groups (Table 2). The most common complaints amongst patients in both groups were ear noise. Mean duration of symptoms was 9.27 months for the c3-dip group and 32.97 months for the c5-dip group, thus indicating a statistically significant difference. While 19.35% of patients in the c3-dip group had problematic symptoms at the opposite side, only 8.16% of patients in the c5-dip group had those corresponding problems (Table 3). On clinical diagnosis, the most common symptoms in the c3-dip group were idiopathic tinnitus and sudden deafness, whereas the most common symptoms in the c5-dip group were idiopathic tinnitus and bilateral high frequency sensorineural hearing loss (Table 4). The most common otologic symptom in both groups was ear noise and the c3-dip group had a statistically significant higher incidence of aural fullness. With regard to history of noise exposure, the c5-dip group had a significantly longer duration of noise exposure, while the c3-dip group had a significantly higher number of head injuries (Table 2). When hearing was compared between both groups, there was a statistically significant difference in mean auditory acuity at 1.0 kHz for the c3-dip group and at 4.0 kHz for the c5-dip group; mean auditory acuity for the c5-dip group tended to be similar between both ears (Fig. 3).

DISCUSSION

Among the otologically well-known notch-type audiograms representative of specific diseases, the notch at 4.0 kHz on audiograms of patients with noise-induced hearing loss was first reported in a study that evaluated workers in noisy workplaces. Noise-induced hearing loss was later found to be related to long-term exposure to noise. 2 It is important to note that this notch is only a possible, not the absolute, basis for diagnosing noise-induced hearing loss. Recent studies have reported that this notch pattern also appeared in perilymph fistulas, ototoxic drugs, head injuries, and hereditary deafness. 3 The notch at 2.0 kHz in bone-conducted hearing loss found in patients with otosclerosis was described in 1950 by Carhart as a unique phenomenon found in sclerosis of the spine. 4 However, this notch is not found in the audiograms of all patients with otosclerosis, and can occur between 1.0 kHz and 4.0 kHz in otitis media with effusion, chronic otitis media, or ossicular disconnection. 5

CONCLUSIONS

In our present study, we investigated characteristics of patient groups showing a notch at 1.0 kHz, which is different from the c5-dip group. The c3-dip group tended to have more female patients, was predominantly unilateral, and had more aural fullness. Additionally, the c3-dip group was more likely to have a history of head injuries, and the mean hearing level at 1.0 kHz in this group was higher than the mean hearing level at 4.0 kHz in the c5-dip group. These results were consistent with the results of a previous study that stated that head injuries correlated with deafness in the mid-frequency range. 6 The mechanisms behind these phenomena should be studied further in future.

REFERENCES