SUPPLEMENT

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Examination of Insert Ear Interaural Attenuation (IA) Values in Audiological Evaluations

Abstract

Purpose: The purpose of this study was to evaluate Interaural Attenuation (IA) in frequency base in the insert earphones that are used in audiological assessments.

Methods: Thirty healthy subjects between 18-65 years of age (14 female and 16 male) participated in our study. Otoscopic examination was performed on all participants. Audiological evaluations were performed using the Interacoustics AC40 clinical audiometer and ER-3A insert earphones. IA value was calculated by subtracting good ear bone conduction hearing thresholds of the worst airway hearing threshold.

Results: In our measuring for 0.125-8.0 kHz frequency were performed in our audiometry device separately for each frequency. IA amount in the results we found in 1000 Hz and below frequencies about 75-110 dB range average is 89 ± 5 dB, in above 1000 Hz frequencies in 50-95 dB range and average it is changed to 69 ± 5 dB.

Conclusion: According to the obtained findings the quantity of melting in the transition between the ears are increasing with the insert earphones. The insert earphone should be beside supraaural earphone that is routinely used in clinics. Difficult masking applications due to the increase in the value of IA can be easily done with insert earphones.

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Interaural attenuation (IA) refers to the amount of interaural melting transition. Differences between IA hearing of level of the tested ear (Hearing Level-HL) and hearing level of the untestable (HL) is the algebraic between dB. The IA depends on the type of transducer used [1,2,3].

Examination of audiological in the air and bone conduction hearing thresholds in both ears is essential to find the individual. Therefore, it is necessary to prevent the passage of sound from one ear to the other ear. Clinically, this can be possible with masking. Masking, ear which is better hearing is noised when testing the bad ones which has lower hearing thresholds (4,5,6). It is quite complex practise and it should be controlled simultaneously to several variables under stringent controls [1,7,8].

Headphone model used in pure tone audiometry test, the patient's personal characteristics such as frequency spectrum and skull thickness of the test signal causes a change in the value of IA [9,10,11,12]. Overall, insert earphones produce greater attenuation between ears than supraaural earphones during pure-tone testing [1,13,14]. *The purpose of this study*, supraaural headphones may be insufficient when routinely uses clinics practices for masking applications. Masking errors can be made with supraaural headphones. Therefore, by determining the value of IA for specific frequency of the insert earphone is to obtain accurate results in clinical practice difficult masking applications.

Methods

The study took place in the clinic of audiology and speech disorders of our tertiary academic medical center. After Ear, Nose and Throat Examination (ENT), immitancemetric examination, ipsi and contralateral acoustics stapedial reflexes, otoacoustic emission (OAE) and pure tone audiometry (PTA) tests were performed on the patients. A total of 30 volunteers between ages 18-65 participated in the study subjects (14 female, 16 male) were compared to values IA. The mean age 42.5 ± 6.21 , the average age of men was 44.5 ± 5.68 . All participants was signed "Informed Consent Form."

"Industrial Acoustics Company (IAC)" two-chamber sound proofed rooms were used for audiological evaluations. Interacoustics AC40 (Assens, Denmark) was made using with insert earphones in clinical audiometry 0.125-8.0 kHz between ER-3A insert earphones. Avarage of pure tone was calculated as the arithmetic average of 500-4000 Hz four frequencies. Immitancemetric and ipsilateral and contralateral acoustic stapedial reflexes measurement Interacoustic AT235H (Assens, Denmark) tympanometry device is used. In immitancemetric 226 Hz probe tone measure the level of violence and 85 dBSPL

TDH-39 headphones are used. In this study, whilst all people who was participated individually were tested OAE measurements with Otodynamics DP Echoport ILO 292 which application is computer-based.

Participants who has ears of a normal (between -10 and +15 dB), while the other ear at least moderate (between 41-55 dB) had sensorineural hearing loss. Air and bone up to 10 dB of hearing thresholds were necessarily. IA value was calculated by subtracting good ear bone conduction hearing thresholds of the worst airway hearing threshold.

Results

In this study, participated who had normal hearing in one ear with the other ear sensorineural hearing loss in IA value of patients were examined. Without the right or left ear separation of the patients it was taken into IA value. In the IA value of 1000 Hz and lower frequencies (125-1000 Hz) 70-105 dB at 1000 Hz and upper frequencies (2000-8000 Hz) was found in the 50-95 dB range.

IA values which are in this study were examined in the 125-8000 Hz 1/1 octave band frequency. Bad weather road at all frequencies using insert earphones with a good ear bone conduction hearing thresholds based on the difference between the hearing threshold values minimum, maximum, average and standard deviation (SD) values were found. Values obtained in the 0.125-8.0 kHz range are also shown (Table 1).

Supraaural headphones are used routinely in the clinic. IA value with supraaural headphones is regarded as 40 dB at all frequencies. In this study, it is increasing the value to insert earphone according to the findings obtained. The lowest values

TABLE 1. 0.125-8.0 kHz between IA value

Frequencies	Min (dB)	Max (dB)	Average (dB)	SD
0.125 kHz	70	95	86	7
0.250 kHz	85	105	94	5
0.500 kHz	80	100	89	6
1.0 kHz	75	90	81	6
2.0 kHz	65	85	74	8
4.0 kHz	55	90	71	12
8.0 kHz	50	80	69	11
Speech	65	80	72	6

Min: Minimum, Max: Maximum, SD: Standart Deviation

were observed between 0.125-8.0 kHz and 69 dB at 8.0 kHz. The highest value is an average of 94 dB at 250 Hz. Supraaural headphones are used with 40 dB as standard in clinical like value for insert earphones are increasing between 29-54 dB.

Discussion

Interaural Attenuation (IA) is the one of important factors for masking. Besides, the minimum masking, maximum masking and over masking are important parameters. The correct masking is possible with all parameters properly selected and implemented with holistic approach. Therefore, knowing of the value of IA is the first step to be done right masking. Masking application is one of the most difficult issues of audiology. Patients give stimulus to an ear whilst the noise in a quiet cabin, to test the patient's other ear and disrupts the cooperation. Therefore if the patients is made to little masking, the results will be affected positively.

Using insert earphones with in our study, we tried to show IA values in the 0.125-8.0 kHz range. These values should be used in the decision making of masking in adults. Audiological examination in routine clinically supraaural headphones are used and IA is taken as the standard 40 dB. Supraaural headphones with 40 dB IA value often leads to unnecessary masking according to the application with insert earphones [15,16]. Therefore, I know the value with the insert earphones and the demonstration of superiority over supraaural headphones are important. It is of the disposable insert earphone. Besides, there are disadvantages such as the unavailability of patients with otorrhea.

Killion *et al.* (1985) studied the difference between supraaural and insert earphone with IA values. Researchers IA values obtained insert earphone is higher than stated supraaural headphones [4].

In addition, measurements made during the 1000 Hz and below the insert earphones IA value at low frequencies, reported that there are more than 1000 Hz upper implications for higher frequencies. Insert earphone with in this study, the IA value of frequency of 1000 Hz and below in the range of about 75-110 dB; In frequencies above 1000 Hz has been found to range from 50 to 95 dB [4,5]. Similar results to the results of this study were obtained in our study. Katz and Lezyns that (2015), adopted on average 60-65 dB value of IA to insert headphones. According to our study results are average values vary between 72-94 dB. Our results are higher than Lezyns Katz and that are based on average values . We believe that at least 72 dB masking needs in IA value according to these results. Accordingly, unnecessary masking condition will also be avoided [15].

Yacullo (2009), insert earphone with deep-seated value of IA, 1000 Hz and below its low frequencies for 75 dB, high frequencies above 1000 Hz is observed as 50 dB [2]. We obtain higher values were obtained according to Yacullo value and can be avoided unnecessary masking situations according to the findings obtained [2].

Chaklina (1967), the insert earphone at low frequencies in particular cause increased value of IA that depends on the reduction in occlusion effect. American National Standards Institute (ANSI, 2004), according to the occlusion effect when the external ear canal is closed or when clogged is increased, especially at low frequencies which are under the 2.0 kHz, the sound of loudness perception transmitted by bone conduction [7]. With the amount of occlusion effect in lower frequency has an inverse relationship between the value of IA [1,2]. Specifically, reducing the effect of occlusion headphones, causing an increase in the value of IA. Deep placed insert earphones will reduce the effect of occlusion, and occlusion of the amount that the ratio of the value of IA is reduced or no effect will also be enhanced [14].

According to the findings, it decreases the amount of transition between the ears and insert the headphones. Therefore, it is necessary to use masking insert the headset one of the most difficult issues of audiology. On the other hand, insert earphones, particularly the external ear canal headphones will be obligatory preferable to supraaural atresia cannot be used in such cases should not be forgotten. Insert the headphones with IA values ranged between 72-94 dB. Therefore there exists the need to mask the specified IA value for each frequency. Exclusively, bilateral conductive hearing loss is not appropriate in the case of masking rules should be strictly insert earphones. In this way more accurate results can be achieved.

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