Maximum Effective Masking Levels in Normal and Pathological Ears*

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The present study was aimed at finding out the maximum effective masking levels in normal and pathological (conductive and sensorineural) ears.

Three groups of subjects were tested. First group had 15 normal hearing (ANSI, 1969 criteria) subjects with no history of any auditory disorder. The second group had 5 mild sensorineural cases. The sensorineural hearing loss was confirmed by the presence of middle ear reflexes. The third group had 12 conductive hearing loss cases ; the pathology was confirmed by impedance audiometry and/or ENT examinations.

The testing was done in a sound proof room, with two room situation, using a two channel (Beltone 200C) Audiometer. For normal hearing group, right ear was the test ear, and for clinical groups, the ear with flat loss was the test ear. The maximum effective masking levels were obtained for each subject at test frequencies, *viz.*, 250, 500, 1000, 2000 and 4000 Hz both at threshold and at 10 dB SL (pulsed tones were used) using NB noise in the nontest ear.

The levels obtained were statistically analysed to determine the means and standard deviations. In addition, significance of difference between means was also computed. The results showed that :

(1) The mean maximum effective masking levels of normals were lower than the mean maximum effective masking levels (predicted and obtained) of conductive hearing loss group.

(2) Maximum effective masking levels could not be determined in sensorineural hearing loss group (pulsed tone was presented to the sensorineural loss ear and NB noise was presented to the normal ear or opposite ear) as the maximum effective masking levels exceeded the maximum output limit of the audiometer. The maximum output for noise was 90 dB EL for all the tested frequencies except at 250 Hz wherein it was 70 dB EL.

(3) The predicted and obtained mean maximum effective masking levels were lowest at 250 Hz and highest at 4000 Hz for the conductive loss ears (test ears).

(4) The difference between predicted and obtained mean maximum effective masking levels (for the conductive loss ears) was sta istically significant at the test frequencies 250, 500, 1000 and 2000 Hz but not significant at 4000 Hz.

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(5) The difference between predicted and obtained mean maximum effective masking levels for conductive loss ears ranged from 4·58 dB (500 Hz) to 16·21 dB (250 Hz). Since the maximum difference between the predicted and the obtained mean maximum effective masking levels is just 16 dB, it can be considered that the difference observed is insignificant for practical purposes (a difference of ± 5 dB in absolute th ehlds is not considered as significant difference in hearing testing). The present study reveals that there is good agreement between predicted maximum effective masking levels and the obtained maximum effective masking levels.

Implications

The finding, that the predicted maximum effective masking levels are nearly equal to the obtained maximum effective masking levels, establishes the validity of the formulae used for calculating maximum effective masking. The present study has resolved doubts regarding the validity of the formula used for calculating maximum effective masking levels. The audiologists can rely on the formula to decide over masking.

Additionally, the data of the present study can be used to find out whether the hearing loss of the subject is conductive or sensorineural hearing loss. *e.g.*, if a subject of mild or moderate hearing loss continues to hear the tones presented at threshold levels to the test ear (pathological ear) when maximum effective masking narrow band noise (90 dB EL) is presented to the nontest ear, the hearing loss of the test ear can be considered as sensorineural hearing loss. The reason is that if the test ear has conductive hearing loss, the subject is not expected to hear the AC tones at threshold level when 90 dB EL noise is presented to the nontest ear. If the 90 dB EL noise in nontest ear fails to mask, AC tone at threshold level in test ear—it indicates that the BC threshold of the test ear is likely to be greater than or equal to 40 dB HL. [because 90–50 (I.A.) = 40]. However, the observation that in 4 normal subjects, AC tones presented to the test ear (at threshold levels) were not masked when 70 dB EL noise was presented to the nontest ear, undermines the previous generalization. Nonwithstanding the type of response of the four normal hearing subjects, the previous generalization can be used with results of battery of tests.

A very important and useful implication of the present study can be explained here. Consider a case of unilateral microtia with atresia. If the case has moderate hearing loss in the ear with normal pinna and external auditory meatus, it will be difficult to find whether the hearing loss is conductive or mixed or sensorineural, as the opposite ear cannot be masked. Using the previously mentioned generalization, it may be possible to know whether the ear with normal pinna and normal external auditory meatus has conductive hearing loss or not. The procedure is simple—present 500 or 1000 Hz tone to the ear with normal pinna and normal external auditory meatus through the earphone, at previously determined threshold level. Introduce narrow band noise at 90 dB EL through earphone placed on the microtia and atresia ear. Ask the subject whether he hears the AC tone presented to the ear with normal pinna. If the subject fails to hear the tone,

conductive hearing loss in the ear with normal pinna and normal ear canal can be suspected.

The above example points out that the procedure of finding whether the subject responds to AC tone in the test ear at threshold level in the presence of 90 dB EL noise (narrow band) in the nontest ear, can be made use of clinically as a test to differentiate conductive and sensorineural hearing loss in difficult cases.

Recommendations

(1) A large number of normal hearing subjects should be tested to find out—in how many normal hearing subjects, 90 dBEL noise (narrow band) in the nontest ear fails to mask the AC tones presented to the test ear at threshold levels.

(2) A large number of conductive hearing loss subjects should be tested to find out—in how many conductive hearing loss subjects, 90 dB EL noise (narrow band) presented to nontest ear fails to mask the AC tones presented to the test ear at threshold levels.

(3) A large number of mild sensorineural hearing loss cases should be tested to find out—in how many sensorineural hearing loss cases, 90 dB EL noise (narrow band) presented to the nontest ear *masks* the AC tones presented to the test ear (sensorineural loss ear) at threshold levels.