NOISE-INDUCED HEARING LOSS AND EFFICIENCY OF COMMUNICATION BY MEANS OF SPEECH

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SUMMARY

The work presents studies on perception of speech, which is the essence of social efficiency of hearing, depending on degree of noise-induced hearing loss. The applied method consisted in processing verbal tests by a computer system that simulated noise-induced hearing loss. A group of young people with normal hearing was used in the study and their intelligibility of speech was determined with appropriately filtered verbal tests. It was found that hearing loss characteristic of noise-induced changes considerably impair understanding of speech.

Keywords: speech audiometry, noise-induced hearing loss

INTRODUCTION

Perception of speech is a very important factor in interpersonal relations. Problems with understanding of speech occur in hearing defects of various origins - also in those caused by noise (2, 17, 18, 21, 23).

Impaired hearing induced by noise in working environment is a very frequent cause of occupational disease certification. About 25% of all illnesses recorded annually concern this disease entity.

This impairment is an irreversible disability that continues until the end of life and makes interpersonal communication difficult. This leads to personality changes, intellectual and psychological degradation. People with impaired hearing often lose the feeling of sense of life.

Occupational hypoacusia, and particularly problems with understanding of speech connected with it are a serious social problem (4).

Speech audiometry is most often used for examination of intelligibility of speech. It is
conducted in such a way that an examined person listens to a verbal test and writes down or repeats the words used in the test. The number of correctly understood words is assessed.

Verbal tests used in speech audiology are prepared for various languages (3, 9, 11, 12, 13, 19, 20). They usually consist of monosyllabic nouns. Such lists are phonetically, semantically, acoustically and structurally balanced. Sometimes logatom tests are used (24) that consist of syllables that have no meaning. Such tests can be used for examination of foreigners that do not have good knowledge of the language of the country in which they stay.

The examined people usually listen to verbal tests played from CD (5, 7, 14) or from a computer with appropriate sound card (10).

Nowadays speech audiology has got wide application (8). It is often used for hearing loss evaluation (1, 5, 6, 22). This kind of test could also be used in realization of the aims of the study, that is the examination of dependence of intelligibility of speech on kind of hearing loss induced by noise with the use of computer simulation.

METHODOLOGY AND SCOPE OF EXAMINATIONS.

In the described study speech audiology was performed using verbal tests prepared in the Clinic of Phoniatrics and Audiology at the Department of Ear, Nose, Throat and Larynx Diseases of Medical Academy in Poznań (15, 16). These tests were recorded on a compact disc.

The examinations were carried out on the group of 25 people 18 - 23 years old. There were 16 women and 9 men in the group. At the beginning of the study the history was taken of all them and circumstances that could affect hearing, such as place of residence, interests and hobbies, past diseases, taken ototoxic drugs were considered. They were also asked about their musical talents and development of their speaking skills. Persons qualified for the examinations were those with good hearing, no hearing problems in the past and without clear musical talents.

Audiometric measurements were taken in the hours from 8 a.m. to 4 p.m.

Basic test, consisting in giving a set of words, was conducted with each person from the group. The examined person wrote down the words she or he heard. Words understood correctly from phonetic point of view were counted for assessment of results. Then verbal tests were played to the examined person after their earlier filtration. In all tests the acoustic signal was given in open field, simultaneously for both ears at the acoustic level of normal conversation.

Test filtration was carried out by reduction of sound level for particular frequencies in audible band. Frequency characteristics of used filters are given in table 1 and on figure 1. Four kinds of filters were used in the examinations - of characteristics typical of gradually increasing
noise-induced hearing loss.

In tests with filters 3 and 4, examinations with filtered signal were carried out at first, which was then made louder. Sound volume was amplified 150% (that is equivalent to increase of sound level by 3.53 dB), 300% (by 9.55 dB) and 500% (by 13.98 dB).

The apparatus used for the examination included: computer set equipped with CD-ROM and sound card Maxi Sound 64 Home Studio Pro, amplifier, loudspeakers, compact disc with recorded verbal tests. Cool Edit Pro Re Mix program was used in the examinations. It made sound processing possible - that is its filtering and increasing sound level.

Every person was examined in the following way:
1. anamnesis,
2. basic test with speech audiometry
3. examination with filter 1
4. examination with filter 2
5. examination with filter 3 and two levels of loudness
6. examination with filter 4 and three levels of loudness

RESULTS

In order to assess the intelligibility of speech, number of words correctly understood in respect of phonetics by the examined people in individual tests was calculated.

The results were analysed statistically. Average values and standard deviations were calculated for each test. The results are presented in table 2. It gives average number of understood words, standard deviation and % of correctly heard words. The results are also illustrated on figures 2.

Initial noise-induced hearing loss do not cause any problems with understanding speech (test with filter 1) or this problems are not big (test with filter 2). As hearing loss increases, discomfort connected with unintelligibility of speech becomes greater. The number of understood words with the used of filter 3 falls from 98% (without filter) to 79%, and with filter 4 - down to 25% - that means that only 1/4 of words are correctly heard. Increasing the volume of sound signal (in the case of filter 3 and 4) even above the level of basic test does not result in full intelligibility of speech.
Tab. 1 Frequency characteristic of filters used in examinations

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<td>Mean hearing loss</td>
<td>15</td>
<td>27</td>
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Tab. 2 Results of examinations

<table>
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<th>Kind of examination</th>
<th>Number of correctly understood words</th>
<th>% of correctly understood words</th>
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<tr>
<td>Basic test</td>
<td>19,6 ± 0,8</td>
<td>98 ± 3,8</td>
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<td>Examination with filter 1</td>
<td>19,7 ± 2,7</td>
<td>98,6 ± 2,71</td>
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<tr>
<td>Examination with filter 2</td>
<td>18,4 ± 1,5</td>
<td>90,6 ± 5,8</td>
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<td>Examination with filter 3</td>
<td>15,8 ± 1,3</td>
<td>79,0 ± 6,3</td>
</tr>
<tr>
<td>Examination with filter 3 and amplification of sound by 3,53 dB</td>
<td>16,3 ± 1,7</td>
<td>81,4 ± 8,6</td>
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<tr>
<td>Examination with filter 3 and amplification of sound by 9,55 dB</td>
<td>17,3 ± 1,3</td>
<td>87,0 ± 6,3</td>
</tr>
<tr>
<td>Examination with filter 4</td>
<td>5,1 ± 2,1</td>
<td>25,4 ± 10,7</td>
</tr>
<tr>
<td>Examination with filter 4 and amplification of sound by 3,53 dB</td>
<td>7,8 ± 2,5</td>
<td>38,8 ± 12,3</td>
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<tr>
<td>Examination with filter 4 and amplification of sound by 9,55 dB</td>
<td>9,9 ± 2,4</td>
<td>49,8 ± 12,2</td>
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<tr>
<td>Examination with filter 4 and amplification of sound by 13,98 dB</td>
<td>10,9 ± 2,5</td>
<td>54,6 ± 12,2</td>
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</table>
Ryc. 1 Frequency characteristic of filters used in examinations

Ryc. 2 Results of speech audiometry
CONCLUSIONS

On the basis of the tests that were carried out it can be said that hearing loss induced by noise considerably reduces intelligibility of speech, and increasing the sound signal volume does not restore fully this function of hearing.

The applied method makes it possible to examine a big number of various types of hearing loss and to foresee their impact on the intelligibility of speech.

REFERENCES


