
ORIGINAL ARTICLE

Hearing loss and communication difficulty in the elderly

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OBJECTIVE: To determine the communicative profile of middle-aged and elderly patients with a high-frequency hearing loss and to discuss the results of audiologic examination in defined age groups.

MATERIALS AND METHODS: The study consisted of 300 subjects aged 40 to 89 years with bilateral symmetric high-frequency sensorineural hearing loss. All subjects underwent audiologic evaluations that included pure tone audiometry, speech audiometry, acoustic immittance measuring, transient-evoked otoacoustic emission testing, and hearing-aid fittings. Conventional audiologic tools were used to evaluate the effects of aging on hearing.

RESULTS: The results obtained from the testing of different age groups in different decades were compared. Hearing thresholds for all octave frequencies of subjects in their seventh or eighth decade were more often statistically significant ($P = 0$) than were those in subjects in their fourth, fifth, or sixth decade. After audiologic evaluation, hearing-aid amplification was offered as a primary rehabilitation tool for all patients.

CONCLUSIONS: The study results show that geriatric hearing impairment usually begins during the seventh decade. The results of audiologic testing revealed hearing impairment in all subjects in their 70s. Hearing loss due to aging leads to considerable communication impairment that diminishes the quality of life for the elderly, their families, and their loved ones. Major rehabilitation tools for the aging population include properly fitted hearing aids and counseling for patients and their relatives. In this study, the importance of rehabilitation and social environmental counseling is emphasized.

Progressive hearing loss is a prevalent chronic condition that primarily afflicts older people. Age-related hearing loss (presbycusis) is characterized by decreased hearing sensitivity, reduced speech recognition in a noisy environment, and decreased central processing of acoustic information. The initial sign of this disorder is a loss of hearing sensitivity primarily at high frequencies in the hearing spectrum. Such changes can begin in young adulthood but usually become evident at the age of 60 years.^{1,2} Over time, the hearing threshold elevation progresses to lower frequencies.^{1,2} Presbycusis tends to be bilateral, symmetrical, and sensorineural in origin.³ The beginning and progression rate of hearing loss vary among individuals and profession groups.⁴

Many factors (ear pathologies, genetic and environmental influences, exposure to ototoxic drugs) contribute to the age-related loss of auditory function.⁴ It has been reported that functional and structural impairments in all auditory pathways begin in the external auditory canal, progress to the cochlea, and then extend to adjacent cortical structures.^{5,6} Atrophy in the cartilage of the external auditory canal has also been observed in elderly individuals.⁵ A more rigid tympanic membrane can result from changes in the morphologic features of that membrane.

Audiologic and clinical manifestations of hearing impairment in the geriatric population are not characteristically uniform. Studies by van Rooij and colleagues⁷ and Rizzo Jr and Gutnik⁸ were conducted to evaluate such discrepancies in the elderly. Although those investigators reached no consensus regarding the most characteristic audiologic parameter of hearing loss in aging individuals, all the elderly patients studied exhibited elevated hearing thresholds and poor speech discrimination scores. Because the histopathologic examination of the temporal bones in the patients studied was not possible, the groups in those² studies were classified according to audiologic criteria.^{7,8}

Another easy and noninvasive technique used to evaluate the hearing of older adults is the otoacoustic emissions (OAE) test, which reflects cochlear function at the outer hair cell level. Outer hair cells are 1 of 2

cochlear receptors that can be stimulated with a low-level signal (< 40 dB SPL). It has been reported that the amplitudes of distortion product otoacoustic emissions, especially in high frequencies, decrease as a result of age-related hearing loss.⁹⁻¹¹

Hearing loss in older adults diminishes quality of life, including physical, cognitive, emotional, and social functioning.^{12, 13} People with age-related sensorineural hearing loss can be helped to overcome that challenge by using audiologic rehabilitation devices such as hearing-assistive equipment or hearing aids or by undergoing cochlear implantation.¹⁴ The aims of our prospective study were to compare the audiologic test results of patients with bilateral sloping high frequency hearing loss and to stress the benefits of appropriate amplification and counseling

MATERIALS AND METHODS

In this study, audiologic parameters from patients aged 40 to 89 years were evaluated. In total, 1150 patients were enrolled in the study. Of those subjects, 324 (28%) had a hearing threshold within the normal range, 300 (26%) had a high-frequency hearing loss, and 526 (46%) had other various types of hearing impairment. In this prospective study, high-frequency sensorineural hearing loss was found to be the most prevalent type of hearing loss; therefore, only audiologic parameters in this group were evaluated. Three hundred patients aged 40 to 89 years (600 ears) were included in the statistical analysis. One hundred twenty-one of those subjects were women, and 179 were men. All patients were evaluated with acoustic immittance measures, transient-evoked otoacoustic emission testing, pure tone audiometry, and speech audiometry.

Pure tone audiometry and speech audiometry were performed in a sound-treated booth (Industrial Acoustic Company IAC). The only speech test used was phonetically balanced words in quiet. Transient-evoked otoacoustic emission test results, which were recorded and analyzed with an ILO-88 OAE Otodynamic Analyzer, were obtained with the "Quick Screen" mode, which generates 80 μ s rectangular clicks at a peak of 80

± 2 dB SPL. In total, 260 sweeps were averaged via band-pass recordings of 1 to 4 kHz. The main audiometric configuration was that of a high-frequency downward sloping hearing loss. Subject selection criteria were based on air-conduction hearing levels from 0.25 to 8 kHz. Bone conduction thresholds in octave frequencies between 500 and 4000 Hz were also obtained. Patients with history of otologic disease, exposure to loud noise, treatment with an ototoxic drug, a severe or profound hearing loss, or a metabolic disease associated with hearing loss were excluded.

All patients were tested with acoustic immittance measures. Their middle ear pressures were within normal limits. Stapedial reflexes in response to 0.5-, 1-, 2-, and 4-kHz pure tone stimuli were also recorded. Rehabilitation with hearing aids was proposed for the patients with verbal communication difficulties. The use of hearing aids and the types of hearing aids worn were also recorded. Pure tone thresholds, tympanogram types, and speech discrimination (recognition) scores obtained from patients in different decades of life were compared. Quantitative data were evaluated with t tests, and statistical significance was assigned to P values of less than 0.01.

RESULTS

We compared the subjects' audiologic test results to determine the effects of aging on hearing level. This study, therefore, is based on the audiologic parameters of various age groups with sensorineural hearing loss. The distribution of sex, the age range, and the mean age of the subjects are presented in Table 1. Pure tone thresholds and the results of speech audiometry in a

typical patient with presbycusis are presented in Figure 1. Average values for air-conduction hearing thresholds in octave frequencies of 0.25, 0.5, 1, 2, 4, 6, and 8 kHz are presented in Figure 2. The mean values for air-conduction hearing thresholds in different decades were compared. The air-conduction hearing thresholds of all frequencies in patients in their seventh or eighth decade were statistically significant ($P = 0$) when compared with those in younger age groups (ie, the fourth, fifth, or sixth decade).

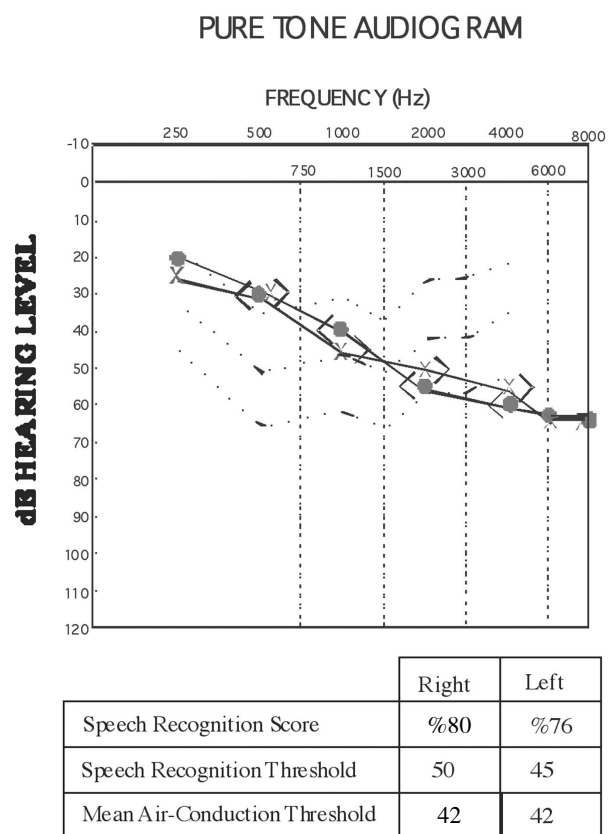


Figure-1: Pure tone thresholds and the results of speech audiometry in a typical patient with presbycusis

Age range (y)	40-49	50-59	60-69	70-79	80-89
Sex (men)	33	39	40	36	31
(women)	15	26	26	31	31
No. patients	48	65	66	67	54
Mean age ± SD (y)	45.45 ± 3.3	55.13 ± 3.02	64.09 ± 2.66	73.8 ± 2.58	82.16 ± 2.75

Table 1: Sex and age distribution of study subjects

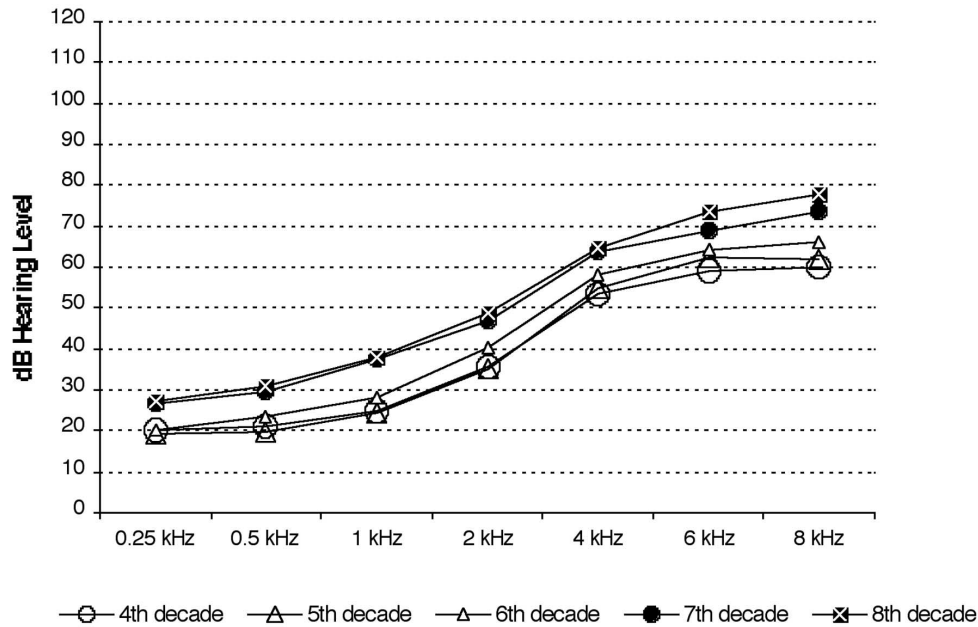


Figure-2: Age-related hearing threshold levels of subjects with presbycusis

Because there were no statistically significant changes in speech discrimination scores between the left and right ears (ie, no significant intraindividual variability), only right ear scores are presented in Figure 3. The speech discrimination scores from patients in their seventh or eighth decade were statistically

significantly different from those of patients in other decades ($P = 0$). The types of tympanograms were classified according to the modified Jerger classification.¹⁵ Type A tympanograms were considered to be a normal test result, and a high frequency of type A tympanograms was noted in all decades. Transient

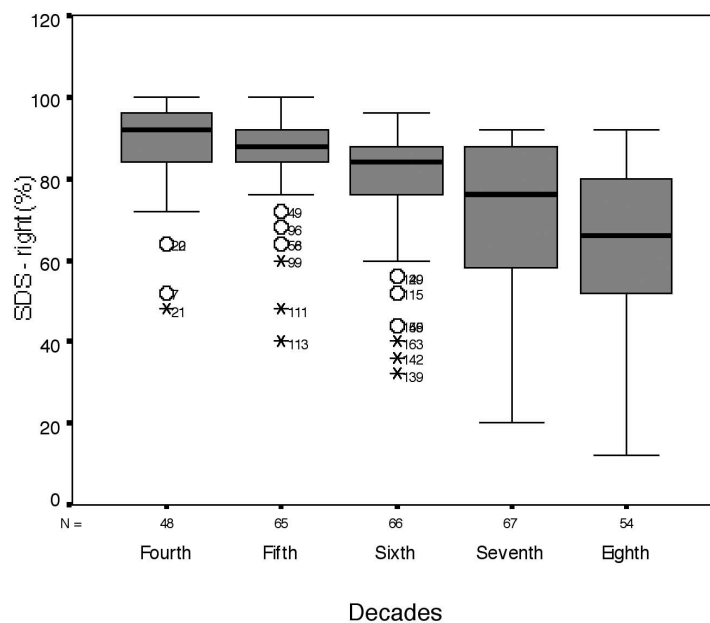


Figure-3: Mean and standard deviation values of right ear speech discrimination scores in patients with presbycusis. Numbers of patients from each decade are also presented in the abscissa. (SDS, Speech discrimination score; N, number of patients from each decade)

otoacoustic emissions were also evaluated in all patients. Otoacoustic emissions were found in only a few subjects with presbycusis and only at 1 or 2 frequencies. This was not an unexpected finding, and these results correlated with those of previous reports.^{9,11}

Hearing aids were recommended for 98 patients in their fifth, sixth, or seventh decade, but only 30 patients were willing to comply. Behind-the-ear hearing aids were the most preferred device by the patients who complied, and the hearing aid types used are presented in Figure 4. None of the patients in their fourth or eighth decade was willing to use a hearing aid.

DISCUSSION

As described by Arnesen in 1982, presbycusis is a slowly progressive impairment of the auditory pathways that begins during the fourth decade of life.¹⁶ However, the results of our study indicate that presbycusis is a far more common pathologic condition in advanced age groups (see Figure 1). In this study, 48 of 300 patients with a high-frequency hearing loss were in their fourth decade, and 67 patients were in their seventh decade (Table 1).

In older adults, the eardrum may become thinner, less vascular, less cellular, less elastic, and more rigid. As a result, abnormal tympanogram results may occur in those individuals.⁵ When other than bilateral type A tympanogram (normal) results are not supported by otoscopic findings, these changes may be associated with aging. Thus the high occurrence of the "abnormally stiff tympanograms" obtained in our patients in their seventh or eighth decade correlates well with findings in the literature.⁵ When we compared the tympanometric results of patients in different age groups, we found that only the results from patients in their fourth decade were statistically significantly different from those of patients in their eighth decade (right ear, $P = 0.006$; left ear, $P = .001$).

Speech discrimination scores for all groups were also compared. The scores from patients in their seventh or eighth decade were statistically significantly lower than those for patients in other decades (Figure 3). We concluded that the impact of aging on hearing levels and speech recognition scores is manifested primarily during the seventh decade. This is a striking finding. The characteristics of all audiologic findings related to aging were uniformly observed in our subjects within that age group. We thus concluded that geriatric hearing impairment begins during the seventh decade of life.

Progressive significant age-related hearing impairment deprives older people of key sensory input, which greatly diminishes their quality of life. If poor speech intelligibility is added to hearing loss, then the communication ability of these patients further decreases and eventually compromises their quality of life.¹⁷ However, modern amplification methods provide improved communication ability for most users.² Depending on the individual's motivational level and readiness to overcome his or her communication handicap, hearing aids or hearing-assistive devices might be helpful for watching television, listening to the radio, or talking on the telephone.¹³ To improve speech intelligibility and communication abilities for the patients in our study, we recommended hearing aids to 98 (33%) of 300 subjects. Unfortunately, only 30 patients from various age groups were willing to use a hearing aid in their everyday life. Negative feelings regarding the use of a hearing aid were most common in patients in their fourth or eighth decade. Significant hearing loss and lower speech perception in patients in their eighth decade could lead to severe verbal communication problems as well as poor adaptation to amplification with hearing aids. We found that very elderly patients (those aged 80 years or older) often objected to wearing a hearing aid because of very poor speech discrimination or a physical impairment that rendered handling the device difficult and that no

patients in their fourth decade were willing to try a hearing aid, despite the need for amplification. Such reluctance to comply can lead to social communication problems, emotional isolation, and a restricted social environment.

According to our study, speech discrimination scores decreased with statistical significance as the patient's age increased. Hearing aid use was inversely proportional to speech discrimination scores: When speech discrimination scores and hearing thresholds decreased, then the acceptance of a hearing aid increased. The behind-the-ear hearing aid (Figure 4) was the most preferred type of hearing aid.

Verbal communication is a 2-way process: The burden of communication falls equally on the speaker and listener. The speaker should talk face-to-face with the listener, speak clearly and unhurriedly, turn off other competing sound sources (TV, radio), and ensure that the message was received. Hearing-impaired listeners should be encouraged to overcome verbal communication problems so that the unpleasant feeling of having misunderstood the content of a conversation can be avoided.¹³

In conclusion, we found that elderly patients with a high-frequency sloping hearing loss demonstrated low speech intelligibility. Elderly people with a hearing loss and their family members should be well informed about hearing disabilities, educated about the use of hearing aids, and regularly monitored for problems with those devices. Especially in the elderly, audiologic evaluations and hearing aid fittings should be performed by a skilled audiologist, and counseling after each fitting is necessary. These patients should be monitored annually with otolaryngologic and audiologic evaluations, and the need for hearing-aid adjustment should be identified. By providing that type of care, audiologists and otolaryngologists can help to improve the quality of life of elderly patients with a hearing impairment.

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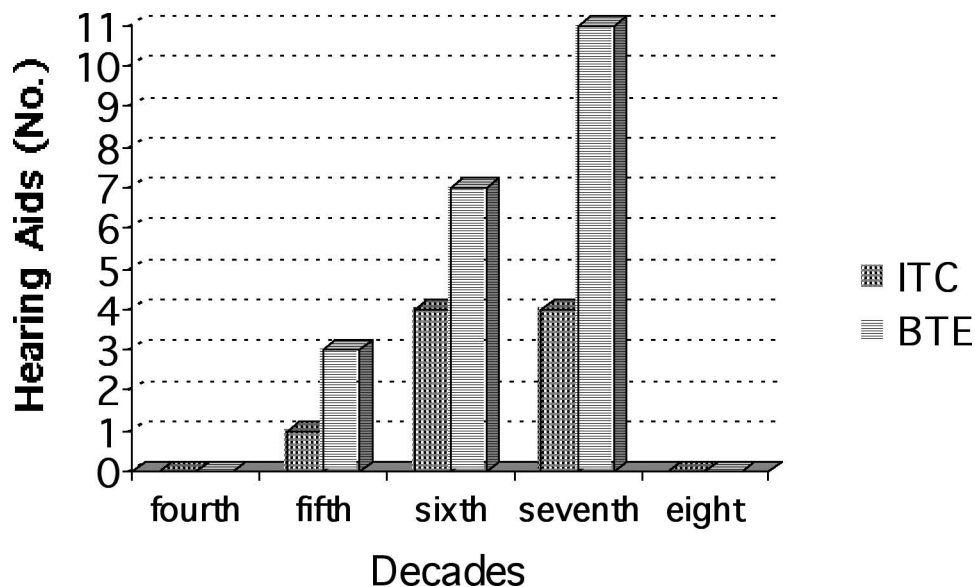


Figure-4: Number of subjects with a hearing aid and the types of hearing aids used (ITC:, In-The-Canal hearing aid; BTE:, Behind-The-Ear hearing aid.

REFERENCES

1. Weinstein EB. Presbycusis. In: Katz J, editor. Handbook of clinical audiology. 4th ed. Baltimore: Williams & Wilkins; 1994. p. 568-84.
2. Gates GA, Mills JH. Presbycusis. *Lancet* 2005;366:1111-20.
3. Gates GA, Cooper JC Jr, Kannel WB, Miller NJ. Hearing in the elderly: the Framingham cohort, 1983-1985. Part I. Basic audiometric test results. *Ear Hear* 1990;11:247-56.
4. Schuknecht H. Pathology of the ear. Baltimore: Williams & Wilkins; 1994.
5. Willot JF. Aging and the auditory system: anatomy, physiology, and psychophysics. San Diego, CA: Singular Publishing Group, Inc; 1991.
6. Jennings CR, Jones NS. Presbycusis. *J Laryngol Otol* 2001;115:171-8.
7. van Rooij JC, Plomp R, Orlebeke JF. Auditive and cognitive factors in speech perception by elderly listeners. I: Development of test battery. *J Acoust Soc Am* 1989;86:1294-309.
8. Rizzo SR Jr, Gutnick HN. Cochlear versus retrocochlear presbycusis: clinical correlates. *Ear Hear* 1991;12:61-3.
9. Stenklev NC, Laukli E. Transient evoked otoacoustic emissions in the elderly. *Int J Audiol* 2003;42:132-9.
10. Cilento BW, Norton SJ, Gates GA. The effects of aging and hearing loss on distortion product otoacoustic emissions. *Otolaryngol Head Neck Surg* 2003;129:382-9.
11. Oeken J, Lenk A, Bootz F. Influence of age and presbycusis on DPOAE. *Acta Otolaryngol* 2000;120:396-403.
12. Marcincuk MC, Roland PS. Geriatric hearing loss. Understanding the causes and providing appropriate treatment. *Geriatrics* 2002;57:44, 48-50, 55-6 passim.
13. Weinstein BE. A primer on hearing loss in the elderly. *Generations-San Francisco-American Society on Aging*, 2003; 27(I):15-19.
14. Milstein D, Weinstein BE. Amplification: The treatment of choice for presbycusis. *Geriatrics & Aging* 2003;6(5): 19-21.
15. Hall JW III, Chandler D. Tympanometry in Clinical Audiology. In: Katz J, editor. Handbook of clinical audiology, 4th ed. Baltimore: Williams & Wilkins; 1994. p. 283-99.
16. Arnesen AR. Presbycusis-loss of neurons in the human cochlear nuclei. *J Laryngol Otol* 1982;96:503-11.
17. Gratton MA, Vazquez AE. Age-related hearing loss: current research. *Curr Opin Otolaryngol Head Neck Surg* 2003;11:367-71.