Classification of Noise and Environmental Stimuli by the Auditory Impression of Cochlear Implant Users

Takeshi Murakami [1], Kimio Shiraishi [2], Takashi Nakagawa [1]

[1] *Department of Otorhinolaryngology, Faculty of Medicine, Fukuoka University*

[2] *Department of Human Science, Graduate School of Design Kyushu University*

Abstract

In the present study, we investigated how cochlear implant（CI）users recognize noise and environmental stimuli by comparing the auditory impression to subjects with normal hearing（NH）.

Methods: Subjects comprised the CI group and the NH group. There were 8 patients with CIs（4 males and 4 females, mean age 68.8 years, range 57-86 years）in the CI group. Thirty-two subjects（18 males and 14 females, mean age 67.4 years, range 61-83 years）with normal hearing were included in the NH group. The semantic differential（SD）method was used to measure the auditory impression to each sound stimulus using 14 bipolar adjective pairs. Each examinee evaluated 14 bipolar adjective pairs for 38 sound stimuli at two sound intensities of 65 dB and 75 dB. A hierarchical cluster analysis using the Ward method was performed using a matrix of the average score in each group composed of 38 sound stimuli and 14 bipolar adjective pairs as the rows and columns, respectively. A factor analysis was conducted to explore the difference in the structure of auditory impression for the sound stimuli.

Results: The cluster compositions differed between the groups. This finding indicated that the auditory impression of the CI group differed from that of the NH group. There were three variables among 14 adjective pairs to describe the auditory impression evaluation of 38 sound stimuli, whereas the CI group demonstrated two variables. The contribution of each variable was dependent on the sound intensity. The characteristics of factors I and II were monotonous and dynamic in time and frequency, respectively. The results indicated that CI users distinguished two different sound structures by the auditory impression compared to three in the NH group.

Discussion: We performed a factor analysis to explore the variables in the auditory impression. Three factors, pleasantness, sharpness and powerfulness, are experienced by the NH group, whereas only two variables are experiences by the CI group. A change in the sound intensity can affect factor loading in each factor. According to acoustic analysis, the characteristics of factors I and II are monotonous and dynamic in time and frequency, respectively. The stimulus spectrum could be referred to as the skeletonized spectrum. This might explain why fewer variables are necessary to explain the auditory impression in CI users. Thus, the temporal change may be the most important factor to distinguish the difference.