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To evaluate the spectral discrimination capacity using ear electroencephalogram (Ear-EEG) in listeners with normal hearing and hearing loss: a preliminary study

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Abstract— **The spectral discrimination capacity is essential to recognize speech. In this study, the feasibility of the Ear-EEG approach as an electrophysiological method to evaluate spectral discrimination capacity was determined. Acoustic change complex evoked by spectral ripple reversal was acquired in most subjects. The amplitude was reduced in the hearing loss group.**

I. INTRODUCTION

As sound contains spectral and temporal information, spectral discrimination capacity is an important factor to recognize significant sounds like speech and music. However, it is known that a listener with hearing loss has reduced spectral discrimination capacity than that of a normal-hearing listener. This study aimed to confirm the potential of the ear electroencephalogram (Ear-EEG) approach for evaluating spectral discrimination capacity electrophysiologically.

Acoustic change complex (ACC), a type of auditory evoked potential, and spectral ripple stimuli used in behavioral spectral ripple discrimination test were utilized for the objective test to determine spectral discrimination capacity.

II. METHODS

Five subjects with normal hearing (NH) and three subjects with hearing loss (HL) participated in this study. The electrode location for Ear-EEG was behind the ear. Reference and ground electrodes were placed contralaterally and ipsilaterally to the ear electrode, respectively. Electrophysiological acquisition was conducted using Neuroscan system.

The stimulus was presented to the contralateral side of the ear electrode using an ER-3A insert earphone. The stimulus comprises 1.5s standard ripple, 0.5s 90-degree phase-shifted inverted ripple, and 2s silence period. The stimulus density, ripple per octave of ripple stimuli, ranged from 0.5 to 5.657.

The stimulus levels were 65 dBA and the most comfortable level for NH and HL groups, respectively. Total sweeps were at least 300. During the recording, subjects were instructed to stay awake while watching captioned videos in a reclining chair in a soundproof booth.

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III. RESULTS

Grand average waveforms acquired from NH and HL groups were indicated in Fig 1. The ACC response was observed after inverted ripple presentation at a point of 1.5s in both groups. Amplitude was defined as a difference between N1 and P2 peaks. The amplitudes were 1.2521 μV for the NH group and 0.4925 μV for the HL group.

Moreover, the ACC amplitude decreased with increased spectral ripple density, and consequentially, the ACC response disappeared beyond the threshold rpo level which was 4 and 1.414 rpo for NH and HL groups, respectively.

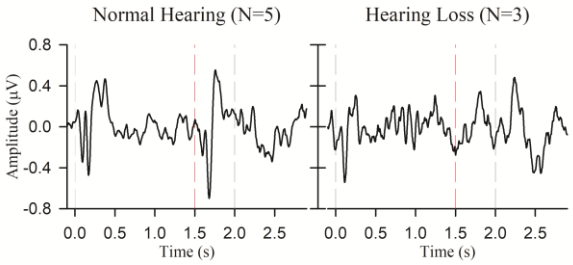

Figure 1. Grand average waveforms of each group.

IV. DISCUSSION & CONCLUSION

The ACC response evoked by spectral ripple reversal was observed on Ear-EEG. The ACC amplitude of the HL group had a lower value than that of the NH group. This result could be interpreted that the spectral discrimination capacity of the listener was reflected on the Ear-EEG.

Further studies with more subjects and various clinic populations are needed to confirm the validity of the Ear-EEG approach to evaluate spectral discrimination capacity.

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