

Spread of Excitation (SoE) – a non invasive assessment of cochlear implant electrode placement

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INTRODUCTION

Speech processor fitting is based on at least two foundations: subjective assessment (e.g. psychoacoustic measurements and speech tests) and objective measurements.

Among different kinds of objective assessment of auditory pathway, the measurement of electrically evoked compound action potentials could provide useful information about functioning of cochlear nerve.

The action potentials that result from a stimulus applied on a given intracochlear electrode are recorded from a neighboring electrode, then amplified and sent to the computer to be displayed and analyzed.

Recording software utilizes stimulus-artifact minimizing algorithm that involves two kinds of stimuli, named probe and masker.

In the subtraction method, implemented in software, the additional signal, called masker is presented during some recordings shortly before the stimulus, called probe. In the condition masker-plus-probe the recording contains stimulus artifact and doesn't contain neural response to the probe as the neural population is still in the refractory state. This recording is subtracted from the response recorded in the probe-alone condition, which contains stimulus artifact and neural response to the probe. The subtraction allows the ECAP to be separated from stimulus artifact. To take advantage of masking, the probe and masker are presented on the same electrode.

However when the probe electrode position is fixed while the masker electrode position is varied across the electrode array longitude, then the masker does not fully mask the probe. As the masker electrode is further from the probe electrode the masking will be weaker. This in turn will result in a smaller amplitude of recorded neural response. The amplitude of the response measured in the condition when the probe electrode is fixed while the masker electrode is varied across the electrode array provides information about the amount of masking which is dependent on the extent of overlap of the excitation regions of the masker and probe electrodes (Brown 1995) , (Cohen 2003) (Fig. 1)

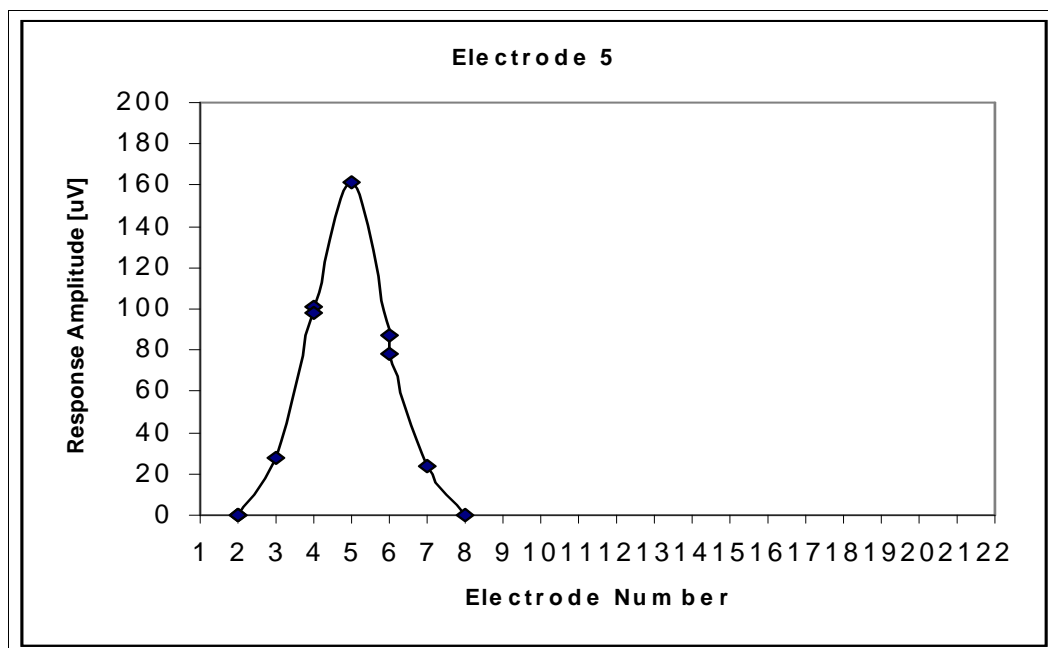


Figure 1 Typical, one-peak shape of Spread of Excitation (SoE)

AIM

Due to the fact that some disturbances in shape of SoE were found, the aim of this study was to evaluate possible dependence between shape of the Spread of Excitation profile (especially number of peaks when stimulating one electrode) and electrode placement assessed by CT scans in Nucleus 24 implant users

METHOD AND MATERIAL

Postoperative Spread of Excitation profiles recordings were made for electrode number 5, 10, 18 in more than 200 adult Nucleus 24 cochlear implant users. Two patients were identified with a SoE profile abnormalities: patient I.O. – 34 years old female, postlingually deafened, implanted with CI24, straight electrode, and patient S.S. - 12 years old male, postlingually deafened, implanted with CI24 implant, straight electrode as well.

CT scans using the cochlear view technique were performed for both patients.

RESULTS

For both patients atypical, a double-peak shape of SoE was confirmed

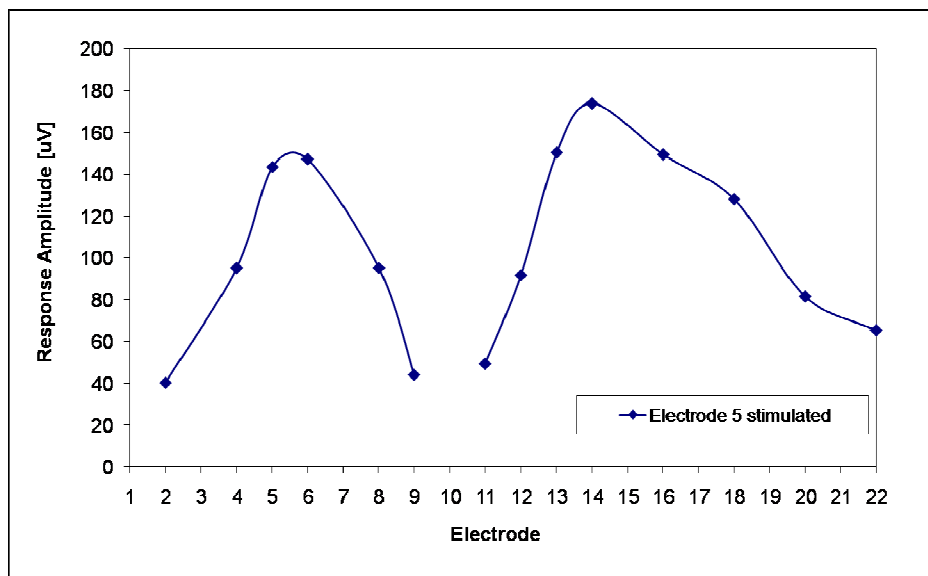


Fig 2 Shape of SoE for patient I.O. with electrode 5 stimulated

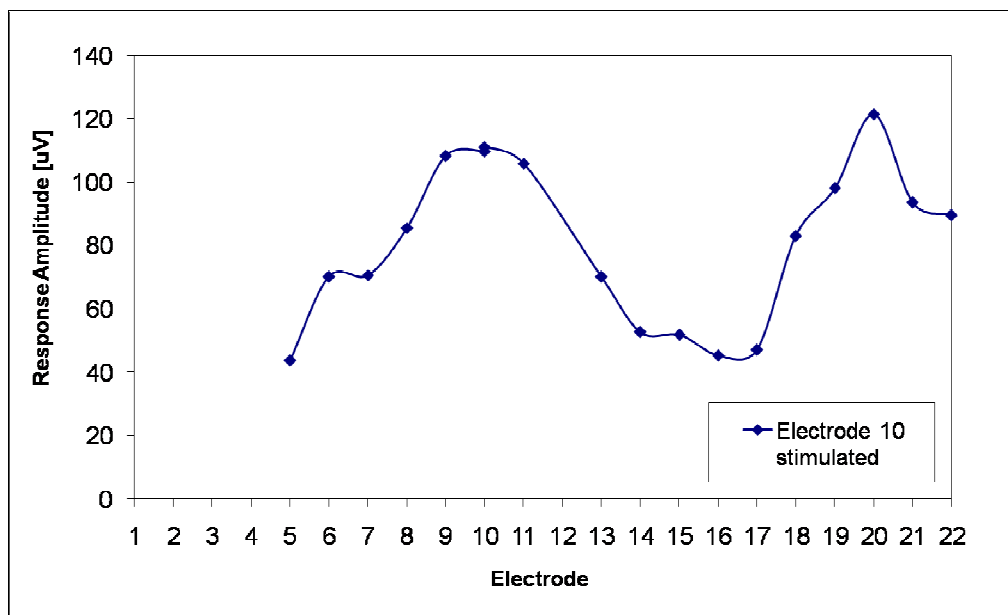


Fig 3 Shape of SoE for patient S.S. with electrode 10 stimulated

Additionally abnormalities in both patients electrode placement was discovered using CT - we discovered electrode loop in both CT scans.

CONCLUSIONS

A correlation between disturbance of the Spread of Excitation profile and abnormalities in implant electrode placement was confirmed in two patients. Further investigation in bigger group of Nucleus 24 implant users is planned to check if there is a general correlation.

A subsequent confirmation of this correlation would provide an useful, noninvasive, objective tool to assess implant electrode position and placement and provide important information, crucial for speech processor fitting. It could be useful especially for child, CI users, due to its tolerance to movement during measurement as opposed to Computer Tomography

Bibliography

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