

Eighth Quarterly Progress Report

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Speech Processors for Auditory Prostheses

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I. Introduction

The main objective of this project is to design, develop, and evaluate speech processors for implantable auditory prostheses. Ideally, such processors will represent the information content of speech in a way it that can be perceived and utilized by implant patients. An additional objective is to record responses of the auditory nerve to a variety of electrical stimuli in studies with patients. Results from such recordings can provide important information on the physiological function of the nerve, on an electrode-by-electrode basis, and can be used to evaluate the ability of speech processing strategies to produce desired spatial or temporal patterns of neural activity.

Work and activities in this quarter included:

- A two-week visit by new subject ME-23, using a Med-El cochlear implant on one side and having substantial residual acoustic hearing on both sides, January 5-16.
- A visit by investigator Artur Lorens from Warsaw, Poland, to collaborate in studies with ME-23.
- Studies with new local subject ME-24, who has bilateral Med-El implants, January 19-20.
- Initial studies with subject NP-8, the second in a series of four patients implanted with an experimental version of the Nucleus device, with a Contour electrode array and a percutaneous connector, February 2-3.
- An invited presentation by Blake Wilson at the *II Meeting Consensus on Auditory Implants*, in Valencia, Spain, February 22.
- Further studies with subject NP-8 the week of March 1-5, to evaluate new processing strategies using dual-resonance, non-linear filters, designed to reproduce aspects of non linear responses and tuning at the basilar membrane and associated structures in normal hearing (see the prior Quarterly Progress Reports 6 and 7 for this project).
- A visit by consultant Enrique Lopez-Poveda to collaborate in studies with NP-8.
- Studies with Nucleus Contour Electrode percutaneous subject NP-7, March 10-12.

The studies with subject ME-23 in particular increased our knowledge about the efficacy of combined electric and acoustic stimulation (EAS) of the auditory system and also afforded the possibility to compare pitches evoked by electric stimuli with those evoked by acoustic stimuli. In general, the pitches evoked by electric stimuli are matched with frequencies of acoustic sinusoids that are far lower than would be predicted by Greenwood's map.

Manuscripts are in preparation to describe our findings from studies with six EAS subjects, and from the combined findings from our studies at RTI and studies conducted at the J. W. Goethe Universität in Frankfurt, Germany, at the University Hospital Clinic in Vienna, Austria, and at the International Center of Hearing and Speech in Kajetany (near Warsaw), Poland. In addition, a separate manuscript is in preparation to describe findings from pitch scaling and matching studies conducted with three subjects in our laboratories and with additional subjects at collaborating institutions (the University of

Iowa and the International Center of Hearing and Speech). These manuscripts should be ready for submission soon, and, when ready, will be included as appendices to future reports.

In addition to these activities, work is underway in our laboratories and elsewhere to represent "fine structure" or "fine frequency" information with implants in a way that the information can be perceived and utilized by patients. The proof pages for a paper in press describing some of this work are presented in Appendix 2 to this report. Results from the other studies mentioned in the list above will be presented in future reports.

II. Plans for the next quarter

Among the activities planned for the next quarter are:

- A one week return visit by subject ME-21, May 3-7.
- Special Guest Address by Blake Wilson at the *VIIIth International Cochlear Implant Conference*, to be held in Indianapolis, Indiana, May 11-14.
- Honorary Speaker Presentation by Blake Wilson at the Med-El Satellite Meeting, *VIIIth International Cochlear Implant Conference*, Indianapolis, IN, May 11–14.
- A visit by Peter Nopp following the Indianapolis conference.
- A return visit for continued studies with Nucleus Contour Electrode percutaneous subject NP-8, May 24-25.
- A return visit for continued studies with Nucleus Contour Electrode percutaneous subject NP-6, June 7-8.
- Initial studies with Nucleus Contour Electrode Percutaneous subjects NP-7 and NP-9.
- Additional studies with local subjects.

III. Acknowledgments

We thank volunteer research subjects ME-23, ME-24, NP-7, and NP-8, who participated in the studies conducted during this quarter.