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Protective Effects of Patterned Electrical Stimulation on the Deafened Auditory System

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ABSTRACT

This Quarterly Progress Report presents a manuscript recently submitted to Hearing Research for consideration of publication in the ***Proceedings of the Second Symposium of Molecular Mechanisms in 'central Auditory Function and Plasticity.***

One important goal of this Contract research is to examine the factors and mechanisms underlying the functional consequences of patterned electrical stimulation delivered by a cochlear implant in the deafened developing auditory system. In electrophysiological recording experiments conducted in the inferior colliculus (IC), we have reported in previous studies that the orderly cochleotopic organization of the central nucleus of the IC develops normally in neonatally deafened cats and is unaltered by the lack of normal acoustic input during development. However, these earlier studies also showed that chronic electrical stimulation of a single bipolar or monopolar channel of a cochlear implant in these neonatally deafened animals induces significant expansion of the central representation of the stimulated cochlear sector and degrades the cochleotopic organization of the IC, decreasing its frequency resolution.

This report presents new data from a recent experimental series of neonatally deafened cats that received chronic stimulation on 2 adjacent bipolar intracochlear channels. Results suggest that stimulation delivered on 2 adjacent channels of a cochlear implant, using highly controlled signals, can maintain selective representations within the central auditory system and prevent the expansion seen with single channel stimulation. Alternate stimulation of 2 channels may be particularly effective in maintaining selectivity, perhaps even sharpening central representations of adjacent stimulated cochlear sectors. In contrast, simultaneous stimulation on 2 channels using a model analogue cochlear implant processor failed to maintain channel selectivity, and resulted in marked expansion and fusion of the central representations of the stimulated channels, suggesting that the central auditory system failed to distinguish these simultaneous, overlapping inputs as distinct.