B7: EFFECTS OF PARTIAL DEAFNESS AND CHRONIC INTRACOCHLEAR ELECTRICAL STIMULATION ON AUDITORY AND ELECTRICAL RESPONSE CHARACTERISTICS IN PRIMARY AUDITORY CORTEX

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The use of cochlear implants in patients with severe hearing losses but residual low-frequency hearing raises questions concerning the effects of chronic intracochlear electrical stimulation (ICES) on the cortical representation of auditory and electrical stimuli. We recorded cortical responses to tonal stimuli and to ICES in primary auditory cortex (AI) of two groups of neonatally-deafened cats with residual high-threshold, low-frequency hearing. One group was implanted with a multi-channel intracochlear electrode at eight weeks of age, and received chronic ICES for up to nine months before cortical recording. Cats in the other group were implanted immediately prior to cortical recording as adults. In all cats in both groups, multi-neuron responses throughout the rostro-caudal extent of AI had low characteristic frequencies (CFs) in the frequency range of the residual hearing and high-thresholds at their new CFs. It is unclear whether this dramatic change in frequency organization reflects cortical plasticity or is simply a passive consequence of the lesion. Acoustic threshold and minimum latency at CF did not differ between the two groups, but in the chronic ICES animals there was a higher proportion of electrically but not acoustically excited recording sites (28% and 10% respectively; $P < 0.01$; Chi-square test). Chronic ICES also resulted in a small but significant ($P = 0.04$; T-test) decrease in minimum latencies to ICES. In sum, chronic ICES did not alter the basic auditory response characteristics of AI neurons or change the frequency organization of AI in animals with residual low-frequency hearing. However, there was a significant increase in the proportion of AI sites only responsive to ICES, particularly in the region of AI that would represent the cochlear base (i.e. proximal to the electrode array) in normal hearing animals. It is possible that the more effective and frequent activation of cortical neurons by electrical input during the period of chronic ICES resulted in a relative strengthening of synapses conveying electrical input to the neurons at these sites. The perceptual consequences of the increased cortical area responsive only to ICES are yet to be determined.

This work was funded by NIDCD (NO1-DC-3-1005 & HHS-N-263-2007-00053-C). The Bionic Ear Institute acknowledges the support it receives from the Victorian Government through its Operational Infrastructure Support Program.