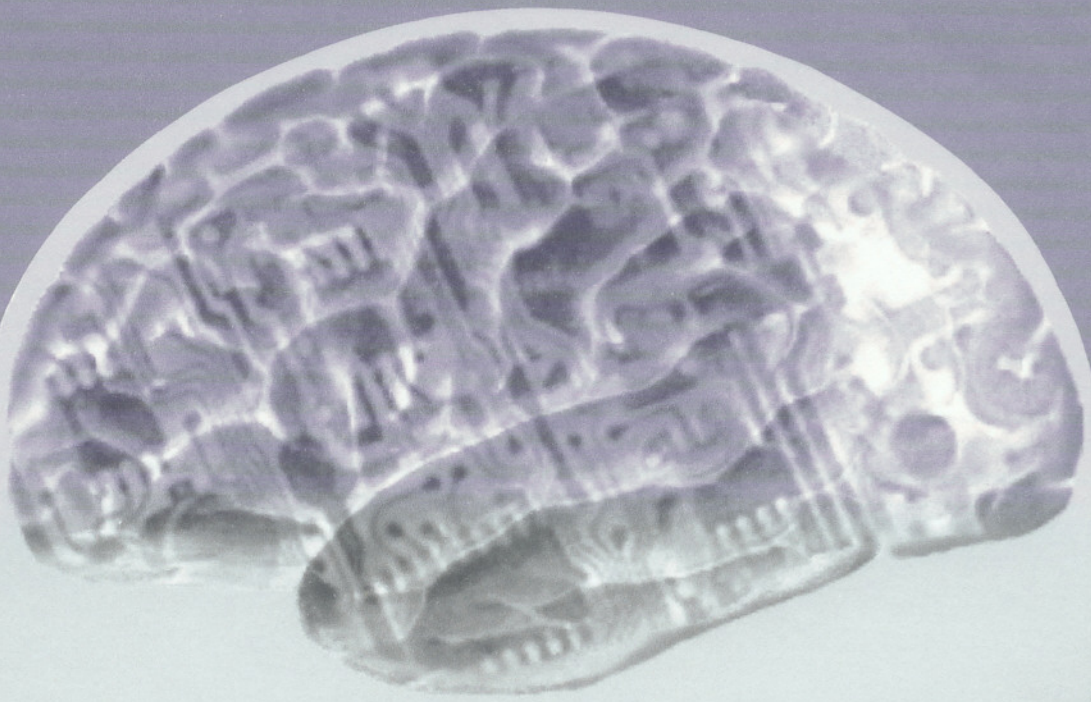
National Institute of Neurological Disorders and Stroke



Neural Interfaces Workshop

November 15-17, 2004

Hyatt Regency Bethesda Hotel • Bethesda, Maryland

NATIONAL INSTITUTES OF HEALTH

NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE

National Institute on Aging

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NICHD National Institute of Child Health and Human Development

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AGENDA

Poster Board Numbers	Primary Presenters	Poster Abstract Titles
22	Hyun-Jung Lee	Biomechanical Analysis of the Effect of Neurointegrative Coating on Si-Microelectrode-Induced Strain in the Brain
7	Kendall Lee	Abolition of Spindle Oscillations and 3 Hz Absence-Seizure-Like Activity in the Thalamus by High Frequency Stimulation: Potential Mechanism of Action
8	Zachary Levine	Tardive Opisthotonos Treated with Bilateral gpi DBS
9A	Duncan Lowne	A Practical Laboratory Course for Introducing Brain-Computer Interfaces
23	Kip Ludwig	Chronic Neural Recordings Using Silicon Micro-Electrode Arrays Electrochemically Deposited With a Conductive Polymer
24	Karen Moxon	Nanostructured Porous Silicon Scaffolds for Enhanced Biocompatibility of Multichannel Microelectrodes
9B	Barbara Nguyen-Vu	Carbon Nanotube Nanoelectrode Array for Electrophysiology
36	Richard North	Implanted Stimulator Adjustment to Maximize Battery Longevity: A Randomized, Controlled Trial Using a Computerized, Patient-Interactive Programmer
37A	Seung Jae Oh	In Vitro Assessment of Tissue Damage Following Insertion of Micromachined Neural Prosthetic Devices
37B	Sung Jae Oh	Measurement of Tissue-Deformation Force by Insertion of Multi-Shank Silicon Neural Probes into Rat Brain
38	William O'Shaughnessy	Neural Implant Passivation Coating by Hot Wire CVD
25	Ryan Pope	Bioprinting for Multi-site, Micro-Drug Delivery with Implantable Microelectrode Arrays and Selective Cellular Binding on Plnar MEA's
39	Scott Retterer	Device Fluidics for Direct Brain Delivery - A Tool for Studying Brain Injury

Measurement of Tissue-Deformation Force by Insertion of Multishank Silicon Neural Probes Into Rat Brain

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The need to record data from an increasing number of neurons has led to the development of large-scale microelectrode arrays. Silicon microelectrode arrays take up a much smaller volume in the brain than conventional wire arrays and, thus, cause less tissue injury. However, monitoring many neurons requires a large number of recording sites and, hence, tends to cause greater tissue injury. These conflicting requirements of many recording sites and minimal tissue injury are difficult to satisfy simultaneously. To determine the optimal strategy for inserting silicon shank arrays for large-scale applications, we used a multiaxis force sensor to measure the force associated with inserting these arrays into the cerebral cortex of rats *in vivo*. All insertions were carried out through the dura to maintain homeostasis of the brain. Devices with three different shank spacings were used: 100 μm (10-shank), 300 μm (5-shank), and 500 μm (4-shank). The cross-section of each shank was 60 μm (thickness) x 100 μm (width), and the shaft length was 5 mm. Insertions were conducted at high (2 mm/sec), intermediate (0.5 mm/sec), and low (0.125 mm/sec) speed. Immunohistochemistry for laminin was used as a measure of tissue trauma. We found that the insertion force of the fully advanced array increased with decreasing insertion speed. For example, when the high-density array with 100 μm spacing was inserted at 2, 0.5, and 0.125 mm/sec, the mean insertion forces were 88±38, 270±96, and 962±171 mN, respectively. A similar dependence on probe velocity was observed for the devices with shank spacings of 300 μm and 500 μm. However, the magnitude of the insertion force decreased dramatically when arrays with large spacings (> 500 μm) were used instead of high-density arrays. The number of vascular elements presented by laminin expression was greatest for the tissue sample from the 100 μm spacing insertion group. On the other hand, the tissue sample from the 500 μm spacing insertion group exhibited a weak laminin signal compared with the other groups. These results demonstrate that multishank arrays should be inserted at high velocity and underline the importance of the design and insertion strategy of high-density arrays with regard to minimizing brain damage.

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