55. Jahrestagung der Deutschen Gesellschaft für Neurochirurgie e.V. (DGNC), 1. Joint Meeting mit der Ungarischen Gesellschaft für Neurochirurgie Deutsche Gesellschaft für Neurochirurgie

25. bis 28.04.2004, Köln

published by gms

Meeting Abstract

Compression of the cerebral cortex during corticotomy: A study of dimpling in rats

Ulrich Knopp - *Dept. of Neurosurgery, Universität zu Lübeck, Lübeck*

W. Jensen - *Center for Sensory Motor Interaction, Aalborg University, Frederik Bajers Vej, Aalborg /DK*

D. T. Kewley - *California Institute of Technology, Division of Biology, MC 216-76, Pasadena /USA*

J. M. Bower - *Cajal Neuroscience Center, University of Texas San Antonio, San Antonio /USA*

K. Yoshida - *Center for Sensory Motor Interaction, Aalborg University, Frederik Bajers Vej, Aalborg /DK*

U. G. Hofmann - *Institut für Signalverarbeitung und Prozeßrechentechnik, Medizinische Universität zu Lübeck, Lübeck*

Deutsche Gesellschaft für Neurochirurgie. 55. Jahrestagung der Deutschen Gesellschaft für Neurochirurgie e.V. (DGNC), 1. Joint Meeting mit der Ungarischen Gesellschaft für Neurochirurgie. Köln, 25.-28.04.2004. Düsseldorf, Köln: German Medical Science; 2004. Doc P 01.1

The electronic version of this article is the complete one and can be found online at: http://www.egms.de/en/meetings/dgnc2004/04dgnc0284.shtml

Published: 23-04-2004

Text

Objective

Intracerebral bleedings or edema are some of the iatrogenic complications of implanting penetrating electrodes into the brain. Given the necessity for invasive surgery for both functional neurosurgery as well as basic neuroscience experiments in the brain, a strategy of using techniques to minimally disrupt the brain surface is commonly

practiced. However, assessment of the damage to the brain tissue during insertion of any kind of probe or catheter has to our knowledge not yet been carried out. We describe the effort to quantify the local displacement of brain tissue during insertion of micro-electrode probes of different shapes using a custom-made force and displacement sensor. The forces and displacement generated by silicon electrodes are compared to more conventional glass and tungsten electrodes.

Methods

These experiments were based on a custom-built force detection device capable of measuring the force applied to a microelectrode at contact and during insertion into the brain. The elasticity of the indented brain was calculated by applying a fit of the Hertz model given the measured opening angle of each microelectrode.

Results

Analyzing the resulting dimpling effect, we were able to determine the elastic modulus of superficial brain tissue to lie in the range of 5kPa to 25kPa. The leading factor influencing dimpling appears to be the opening angle of the tip taper and not the sharpness of the tip itself.

Conclusions

Evaluated in the context of a model of tissue elasticity, we conclude that the pial membrane itself provides most of the resistance to probe entry. This hypothesis is tested by enzymatic digestion of the membrane, which is shown to reduce dimpling by decreasing penetration forces. Based on our study, we suggest changes to conventional tip shapes, which would be expected to reduce dimpling.