Personalized Computer Aided Navigation for Stereotactic Surgery

https://www.neurodegenerationresearch.eu/survey/personalized-computer-aided-navigation-for-stereotactic-surgery/

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Luxembourg

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Personalized Computer Aided Navigation for Stereotactic Surgery

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FNR

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3

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Research Abstract
Deep brain stimulation (DBS) is an established method to alleviate symptoms of movement disorders, particularly Parkinson’s disease. It is based on the implantation of electrodes in deep brain regions and has shown to be very effective. However, side-effects including hypomania, speech-disturbances and pathological gambling occur frequently.The surgery is subject to unavoidable errors, such as physically limited mechanical accuracy. Intra-operative microelectrode recordings (MER), which detect specific neuronal firing, are used for compensation together with test-stimulations. Recently, diffusion tensor imaging (DTI) and simulations of the so-called volume of tissue activated (VTA) by the stimulation are evaluated.

Results suggest that side-effects are caused by unintended coverage of white-matter-fibers near the target structure because of the imprecise navigation.It is hypothesized that it is possible to create an adaptive DBS navigation model in terms of a control system that uses intraoperatively recorded multi-scale electrophysiological data as feedback. This might increase the accuracy of the intra-operative navigation and contribute to a better outcome with fewer side-effects.An analysis of the actual surgical process with its patient-specific accuracy will ensure a safe scientific fundament. A simplified formal model of the DBS navigation process in the sense of a control system will be provided. A basic validation of such a model could be attempted by 3D-printing of real patients? heads from CT-data. This initial static navigation model will then be extended by integrating intraoperatively recorded multi-scale electrophysiological data as a dynamic feedback to improve the navigation process with machine learning methods. The fusion of the different data, which are currently assessed only separately and manually, into an integrated model will lay a foundation for the long-term goal of understanding the ?big picture? of DBS. On mid-term sight, a reduction of adverse effects by a more precise patient-specific navigation may become possible.

Further information available at:

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