Analysis of Adverse Effects of Stimulation During DBS Surgery by Patient-Specific FEM Simulations

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Abstract: Deep brain stimulation (DBS) represents today a well-established treatment for movement disorders. Nevertheless the exact mechanism of action of DBS remains incompletely known. During surgery, numerous stimulation tests are frequently performed in order to evaluate therapeutic and adverse effects before choosing the optimal implantation site for the DBS lead. Anatomical structures responsible for the induced adverse effects have been investigated previously, but only based on stimulation data obtained with the implanted DBS lead. The present study introduces a methodology to identify these anatomical structures during intraoperative stimulation tests based on patient-specific electric field simulations and visualization on the patient specific anatomy. The application to 4 patients undergoing DBS surgery and presenting dysarthria, paresthesia or pyramidal effects shows the different anatomical structures, which might be responsible for the adverse effects. Several of the identified structures have been previously described in the literature. To draw any statistically significant conclusions, the methodology has to be applied to further patients. Together with the visualization of the therapeutic effects, this new approach could assist the neurosurgeons in the future in choosing the optimal implant position.

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