**Study on Incisionless Transcranial Magnetic Resonance-guided Focused Ultrasound Treatment of Neuropathic Pain and Parkinson’s Disease: Safety, Accuracy and Initial Clinical Outcomes**

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**Introduction:** Recent technological developments in MR-guided focused ultrasound (MRgFUS) enable incisionless transcranial therapeutic interventions to the brain. The goal of this study is to establish the safety, targeting accuracy and efficiency of this technique in the treatment of neuropathic pain and Parkinson’s disease. We shall present clinical, radiological and neurophysiological data on 3 month and 1 year follow-ups of neuropathic pain patients, as well as initial results on parkinsonian patients.

**Methods:** Medial thalamic (central lateral nucleus) and subthalamic (pallidothalamic tract) FUS thermocoagulations were performed under real-time MR-imaging and MR-thermometry guidance, applying peak temperatures between 50° and 60°. Patients were evaluated at follow-up visits by two neurologists independent from the functional neurosurgical investigators.

**Results:** The mean absolute targeting accuracy for 30 targets was 0.44 mm for the mediolateral dimension, 0.38 mm for the anteroposterior dimension and 0.66 mm for the dorsoventral dimension. There were no device- or procedure-related complications and no post-treatment neurological deficits. Currently, 12 neurogenic pain patients present at 3-month follow-up a mean pain relief of 51.3%, a mean improvement of their visual analogue scale ratings of 35.7%, and 66.7% of them had a pain relief of or above 50%. A reduction of their quantitative EEG spectral overactivities can be observed particularly in the delta and theta frequency bands. We are collecting initial evidence that thermal ablations in subthalamic dense fiber tracts require more energy application than ablations done in thalamic nuclei. We evaluated this in our last 4 parkinsonian patients, observing that the repeated application of 60° peak temperatures results in better clinical outcomes and a better lesion visualization at 3 months follow-up MR examination.

**Discussion**: This study expands and confirms the already published evidence on MR-guided focused ultrasound in the treatment of neuropathic pain and brings first data on the treatment of Parkinson’s disease. This technology avoids the surgical risks related to brain penetration, and the real-time continuous MR-imaging and MR-thermometry allow an optimized lesioning safety and accuracy. Our experience has shown that the immediate effects of thermal lesioning could be used to enable a closed-loop control and optimization of target lesioning based on these two imaging modalities. In summary, MR-guided focused ultrasound offers a safe and precise option for the treatment of neuropathic pain and Parkinson’s disease. We present for the first time ever initial MRgFUS treatment results for Parkinson’s disease.