

# NEURONAVIGATION OF rTMS BASED ON BRAIN FUNCTIONAL IMAGING IN CLINICAL APPLICATION IN AUDITORY HALLUCINATIONS

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## Summary

Transcranial magnetic stimulation (TMS) represents a noninvasive method used in diagnostics of neurological disorders and physiological research of sensoric, motor and cognitive function and intracortical relations. This method has found its leading position also in the treatment of neuropsychiatric disorders. TMS is based on the administration of short pulses of a strong magnetic field, which induces secondary electric currents in a limited volume of cerebral cortex. Therapeutic modification utilizes a repetitive TMS (rTMS) in which the magnetic coil generate a series of pulses of different frequencies.

Low-frequency rTMS (LF-rTMS) of the left temporo-parietal cortex (LTPC) has been proposed as a useful therapeutic method for auditory hallucinations (AHs). Majority of rTMS studies use “standard” coil positioning, which is often not fully corresponding to cortical area(s) of maximal functional changes. Stereotactic neuronavigation enables the magnetic coil to be targeted according to the individual parameters obtained from neuroimaging. Individualized rTMS neuronavigated according to positron emission tomography ( $^{18}\text{F}$ FDG PET) allows us to focus the coil explicitly on a given area with detected maxima of specific abnormalities, thus presuming a higher therapeutic effect of the method.

The first part of this thesis demonstrates an overview of technical principles, presumed mechanisms of action of rTMS and the specific approaches of rTMS, including the use of neuronavigational system co-registered by neuroimaging data. The thesis summarizes information about AHs, functional imaging findings in AHs and also presents the results of rTMS studies in AHs, including meta analyzes confirming the effect of rTMS targeted on LTPC and neuronavigated rTMS studies that have inspired us for our study. The final experimental part of the thesis presents our study, testing the therapeutic effect of neuronavigated rTMS in the treatment of AHs. A double-blind, placebo-controlled study tested the clinical effect of neuronavigated rTMS, administered to the maxima of metabolic abnormalities evidenced by  $^{18}\text{F}$ FDG PET in related region of LTPC and compared the clinical

efficacy of neuronavigated rTMS with standard rTMS approach and „sham“ (inactive) rTMS. Results of the study confirmed the clinical effect of neuronavigated rTMS and found neuronavigated rTMS the most effective of the trial.

**Keywords:** repetitive transcranial magnetic stimulation, neuronavigation, schizophrenia, auditory hallucinations, positron emission tomography, temporo-parietal cortex