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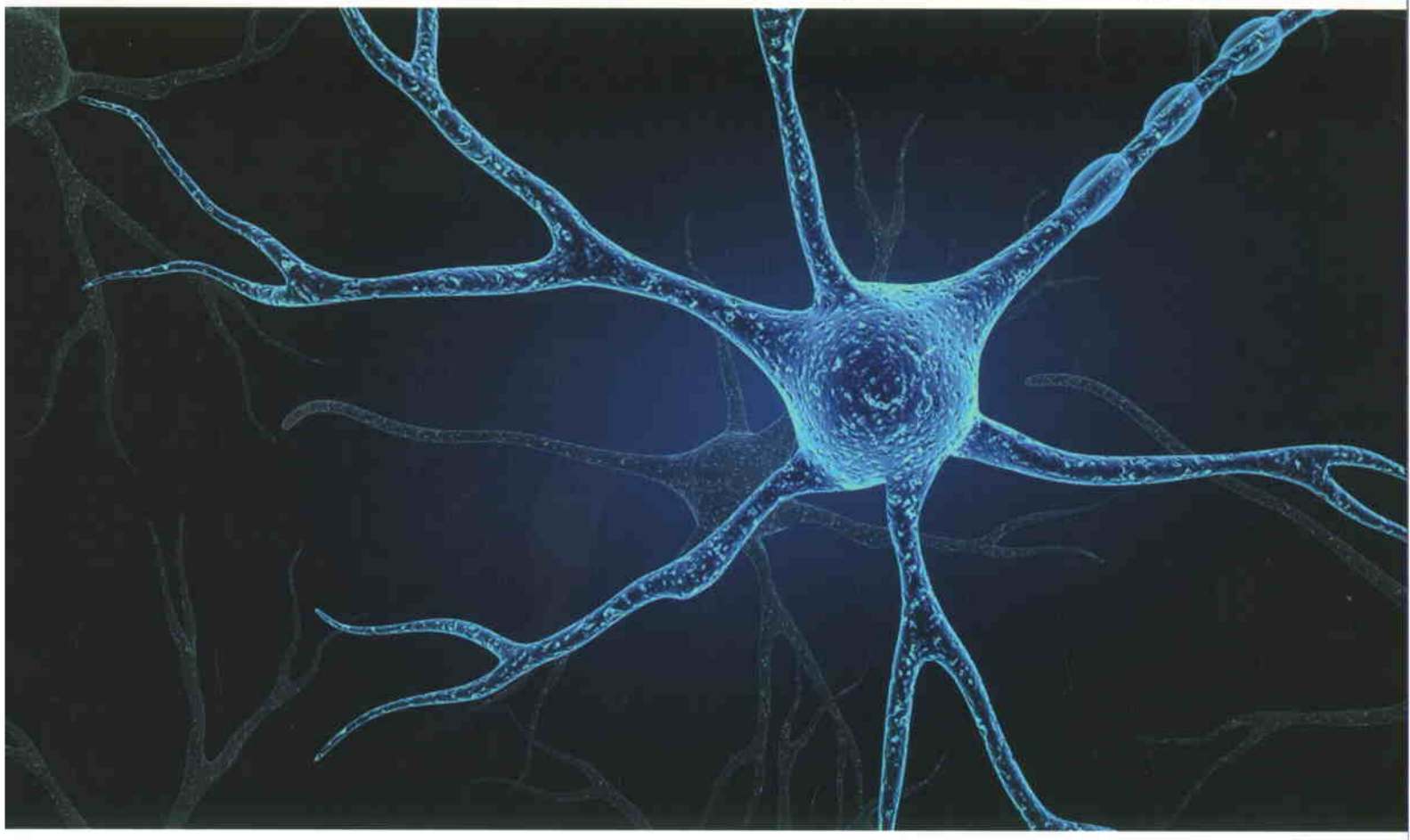

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100

Acoustic analysis of speech progression in Parkinson's disease

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Background: Hypokinetic dysarthria in Parkinson's disease (PD) is a multidimensional impairment of phonation, respiration, articulation, and prosody. While the beneficial effect of dopaminergic therapy on the principal motor symptoms in PD has been well-documented over decades, its effect on speech remains unclear. The aim of this study was to investigate the feasibility of acoustic measures in analyzing the effect of treatment initiation on the progression of speech impairment in PD.

Methods: 19 de novo patients with PD were tested and re-tested after 13-24 months after the introduction of antiparkinsonian therapy. As a control group, 19 age-matched healthy persons were recorded. Speech data included sustained phonation, fast syllable repetition, reading text, and monologue. Unified PD Rating Scale motor subscore (UPDRS III) was rated in both evaluations. Voice parameters were obtained using quantitative acoustic analyses of the key aspects of speech. Subsequently, the evaluation criteria based upon Gaussian kernel distributions, statistical decision-making theory, and minimal detectable change of healthy speech was designed to assess individual changes of parkinsonian speech in the course of treatment.

Results: A trend for speech performances to improve was demonstrated after treatment mainly in quality of voice, loudness and pitch variability, and articulation. The treatment-related changes differed individually across various aspects of speech. Improvements in vowel articulation correlated with treatment-related changes in bradykinesia ($r = 0.45$, $p < 0.05$) and rigidity ($r = 0.52$, $p < 0.05$). In addition, there was a significant correlation between changes in rigidity and pitch variability ($r = 0.45$, $p < 0.05$). Voice quality and loudness variability were improved with dopaminergic medication independently of changes in motor performances.

Conclusions: Acoustic analysis and advanced statistics revealed improvements in speech parameters after the introduction of antiparkinsonian therapy in PD patients. Moreover, changes in vowel articulation and pitch variability appear to be related with dopaminergic responsiveness of bradykinesia and rigidity. Therefore, speech can be considered as a marker of disease progression. Acoustic analysis appears as a helpful tool for monitoring the severity of speech impairment and the effects of therapy in PD.

101

Evaluation of hypokinetic dysarthria in Parkinson's disease and effects of repetitive transcranial magnetic stimulation and dopaminergic treatment by means of voice signal analysis and fMRI

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Introduction: Hypokinetic dysarthria (HD) in Parkinson's disease (PD) is characterized by monotony of pitch and loudness, reduced stress, variable rate, imprecise consonants, and a breathy and harsh voice. Pharmacotherapy and surgery have only partial effects on HD. rTMS is a non-invasive tool used to modulate cortical plasticity and function of various cortical regions and circuitries.

Objective: Based on results of fMRI studies, we explored effects of high-frequency repetitive transcranial magnetic stimulation (rTMS) of the primary orofacial sensorimotor area (SM1) and dorsolateral prefrontal cortex (DLPFC) on paraclinical aspects of voiced speech in PD using voice signal analysis. Effects of dopaminergic treatment on HD have also been assessed using the same voice analysis and fMRI.

Methods: Non-depressed and non-demented subjects with PD (mean age 65.7 ± 7.45 SD, mean PD duration 8.6 ± 3.41 SD) have participated in this ongoing study. Participants underwent 3 sessions of 10 Hz rTMS over the dominant hemisphere with 2250 stimuli/day applied in a random order over the: SM1 (an active stimulation site, 90 % of the motor threshold [MT] intensity), DLPFC (an active stimulation site, 110 % of MT), and occipital cortex (a control stimulation site, 90 % of MT). Detailed speech evaluation and audio-recordings were performed prior to and after each rTMS session. Voice intensity, clarity, prosody, articulation and intelligibility of speech was assessed using physical parameters, such as mean fundamental frequency and its variability, jitter, short-time energy of the signal, shimmer, speech rate, VOT (Voice Onset Time), and Vowel Articulation Index. Wilcoxon matched-pairs test and ANOVA were performed for data analyses. Effects of a single levodopa dose on HD have also been evaluated using the same speech analysis and fMRI data analysis.

Results: rTMS of the left SM1 was associated with significant enhancement of the tongue movements velocity and changes of fundamental voice frequency. This is an interim analysis and the studies are ongoing.

Conclusions: Results of fMRI studies will be discussed with respect to pathophysiological mechanisms of HD and effects of dopaminergic therapy. An interim analysis of our data revealed an improvement of some articulatory and voice parameters of speech induced by rTMS applied over the SM1 of the dominant hemisphere.

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102

Video-oculography in the Movement Disorders Clinic

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Eye movements can be measured with extreme precision, are usually rich in terms of derivable parameters, have been well documented in healthy adults and in patients with brain lesions. Video-based infrared oculography (VOG), or infrared eye tracking, is the most frequently used method to record eye movements in clinical practice. A light source is reflected on the surface of the eye to track horizontal and vertical eye movements. In clinical practice, VOG provides insights into patients with movement disorders due to underlying genetic, degenerative or metabolic disorders. Eye movements are often disturbed early in the course of Progressive Supranuclear Palsy (PSP) and VOG may be helpful in distinguishing it from Parkinson disease. PSP patients show slow vertical saccades, especially downward, with preserved range of movement, slow and hypometric horizontal saccades, disruption of steady gaze, impaired smooth pursuit, loss of convergence and preservation of the vestibulo-ocular reflex. However, patients with Parkinson disease show hypometric horizontal and