with and without medication or subthalamic nucleus (STN) stimulation

INTRO.

Driving a car is an essential everyday coordination task. The many symptoms of idiopathic Parkinson’s disease (PD) span from narrowed attention/ slowed cognition with prolonged sensory-motor latencies to the characteristic motor abnormalities of tremor, rigidity, slowness and hypometria of the patients’ movements.

In vision during smooth pursuit the target is fixed on to the fovea as the eyes track the slowly moving distribution, we used the Mann/Prony Spectrum option, and then Parametric Interpolation and Prediction. The time series data of gaze appears as dynamic Fixations on to moving targets. Fixation during smooth pursuit, appears as dynamic Fixations on to moving targets.

PD patients show inaccurate static and dynamic fixations during driving with consecutive loss of targets and delay of reactions.

METHODS.

Using an infrared camera system (GazeTracker) that allowed completely free head-eye movements within a driving simulator we recorded everyday gaze-head coordination as well as steering, indicating and accelerator/brake signals from our 20 PD patients (mean age 63.4, 4 females) and 20 normal age matched subjects. PD symptoms were graded according to UPDRS pt.1, Hoehn & Yahr, MMQ and Damkiet. Average duration of PD symptoms was 5 years (std 0.9); 19 patients were on dopaminergic medication, all were treated with an implanted STN stimulator (Fig.2), patients that suffered from vertigo and syncope were excluded. After some basic simulator checks and after 5 minutes of practicing with the simulator driving system, they had to drive for five minutes through an unknown realistic course with STN stimulation ON, and after a short pause with STN stim. OFF. In European car driving schools, this kind of simulator course is commonly used for training and testing (Bessier Software: 3d driving school). The time series data of gaze steering/acceleration/brake driving control were analyzed (Autosignal 1.52) using first a fast fourier analysis (FFT) the data were fitted. Parametric model (the fitted curve) is shown in the Y plot. The Y2 plot contains the fitted curve and the data that are highly localized in time. The CWT constructs a high frequency peak in(1) at 130 sec driving time in(1), double integrated power in (1), and very good time and frequency localization. Comparison of CWT with the standard error (SE=1-q) and CWT with the standard error (SE=0.9) showed similar but more variant frequency content and prolonged driving time in(1), double integrated power in (1), and a high frequency peak in(1) at 130 sec the time of driving through the roundabout.

RESULTS: TWO EXAMPLES

Figures 4 to 5 show examples of basic deficits of one typical PD patient with STN ON and Off. On left side of each panel time course of braking (red), accelerating (blue), and steering wheel (green) are depicted.

CONCLUSION I.

On total error amount, STN-Stim ON/Medic.Off showed a significant improvement compared to the baseline double-OFF situation. Medication ON/Stim.Off did not show this effect. For light & medium errors both Medic ON or Stim.Off showed significant improvement in comparison to Medic ON/Stim.Off and with Stim.Off showing significantly higher improvement than Medic ON (p<0.03).

CONCLUSION II.

Our main result was the objective description of the recorded interdependent signals’ decay with respect to driving performance as a function of ON versus OFF STN stimulation, -besides symptom-expression, disease duration and drug therapy. The special case of gaze-arm-foot coordination together with the narrowing of “attention” as a single, most important part of the disease progress, has so far not been realized by most clinical researchers. Our recordings demonstrate the motor & cognitive improvement during a complex attention-orientation task through the ON-STN condition – in addition to the medication effect. We conclude that Parkinson patients’ driving capabilities must be checked very thoroughly during the course of their illness, to avoid predictable traffic accidents.