KINEMATIC ANALYSIS OF REPETITIVE FINGER TAPPING AND THE EFFECTS OF SELEGILINE IN NEWLY DIAGNOSED PATIENTS WITH PARKINSON DISEASE

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Background: Motor impairment in Parkinson's disease includes: i) slowness, i.e. *bradykinesia*; ii) decreased amplitude, i.e. *hypokinesia*, and iii) progressive reduction in speed and amplitude during repetition of finger movements, *i.e. sequence effect* (Agostino et al., 2003, Espay et al., 2011). The kinematic features of the repetitive finger tapping in the early stage of PD are unknown. Also, the pathophysiological mechanisms of the sequence effect in PD are still unclear and they are not entirely explained by dopaminergic loss (Kang et al., 2010).

Objective:

- To evaluate the kinematic features of the repetitive finger tapping in the early stage of PD
- To evaluate the response to Selegiline administration, a selective irreversible MAO-B inhibitor. There is considerable evidence showing that Selegiline has either dopaminergic and non-dopaminergic effects. We thus hypothesized that Selegiline might improve the sequence effect in patients with PD.

Methods:

Participants: We recruited 14 newly diagnosed and previously untreated patients with PD ***TABLE 1.*** Seventeen right-handed, age- and gender-matched healthy subjects (HS) served as a control group. Participants were instructed to repeatedly tap their index finger and thumb as rapidly and as widely as possible for 15s. Three 15s trials were performed by each hand with 60s rest in-between. Patients were evaluated in two separate sessions, performed at least 4 weeks apart: OFF and ON Selegiline (10 mg taken daily).

Kinematic recordings and analysis: We used a motion analysis system (SMART DX 100, BTS, Milan, Italy) to record finger movements in the three-dimensional space. Movement amplitude is expressed in (mm). Movement velocity is expressed in (mm/sec) ***FIGURE 1***. The sequence effect was measured as decrements in amplitude and velocity and during the recording trials.

Statistics: The effects Selegiline on the UPDRS-III score were investigated by means of the Wilcoxon matched-pairs test. Amplitude and velocity during repetitive finger movements were analysed using repeated measure analysis of variance (ANOVA). Statistical significance was determined when $P<0.05$.

Case	Gender	Age	Disease duration	UPDRS-III OFF	UPDRS-III ON
1	F	60	2	23	16
2	M	60	1	26	21
3	M	47	1	14	13
4	M	65	2	18	18
5	M	55	1	18	13
6	M	64	1	19	23
7	M	62	1	24	12
8	F	55	1	24	18
9	M	63	2	33	31
10	F	63	1	37	31
11	F	64	2	23	13
12	M	70	1	25	17
13	M	69	2	9	9
14	M	60	1	22	18
Average±1 St.Dev.	10M/4F	61.21±5.9	1.3±0.4	22.5±7.1	18.1±6.6

Table1. Demographic and clinical features of patients with Parkinson's disease. Gender (M=male; F=female); age and disease duration are expressed in years. The UPDRS= Unified Parkinson's Disease Rating Scale

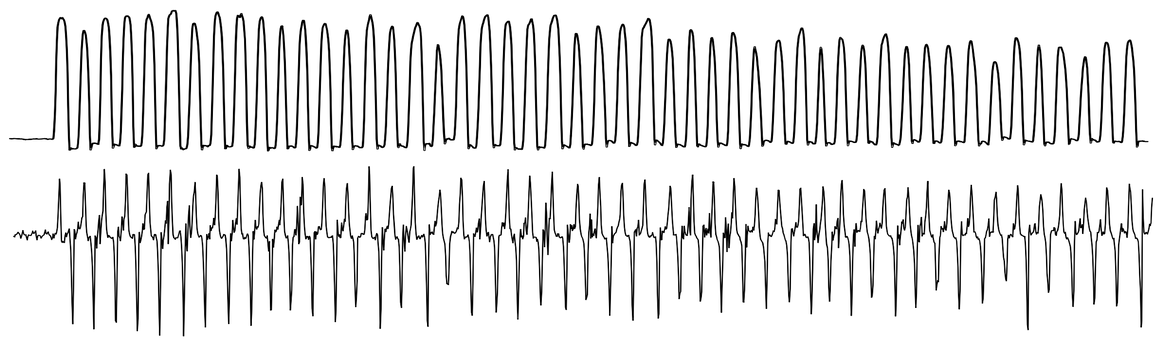
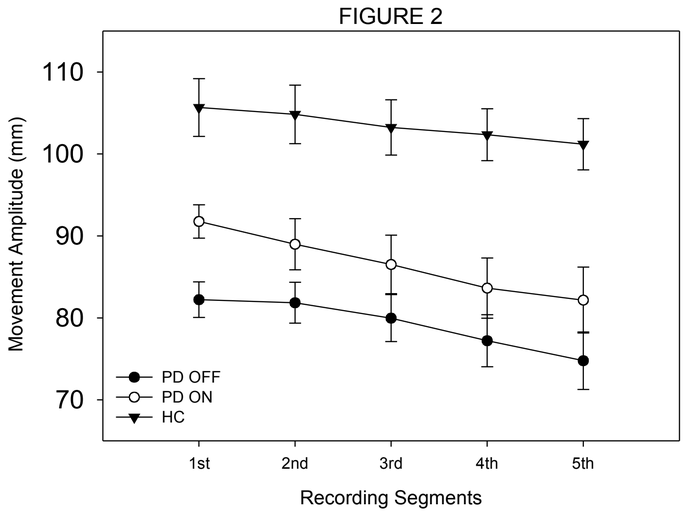


Figure1. Example of one kinematic recording of 15s in one representative healthy subject. The upper panel indicate the movement amplitude. The lower panel indicates the movement velocity

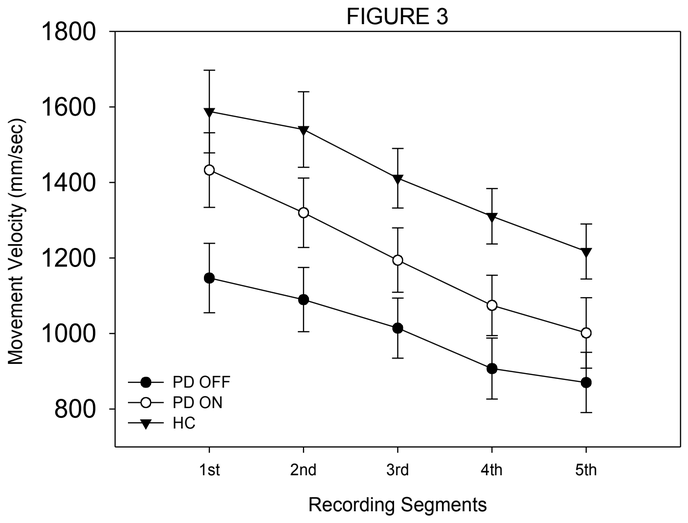
Results: There was significant improvement in the UPDRS III motor score in patients 4 weeks after taking Selegiline (OFF: 22.5±7.1 versus ON: 18.1±6.6; $Z=2.78$, $P=0.005$). PD patents exhibited movements of lower amplitude and velocity than HC, however the decrement of amplitude and velocity across the 15s trials was similar in the two groups. Selegiline administration improved the overall amplitude and velocity of movements in patients but did not modify the course of these variable during the recordings ***FIGURES 2 & 3***.

FIGURE 2



1st Analysis: Two-way ANOVA (between group factor-GROUP; two levels: HC vs. PD OFF; within group factor RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
GROUP: $F(1, 29)=30.60$, $P<0.001$
REC.SEGMENT: $F(4, 116)=14.64$, $P<0.001$
GROUP X REC.SEG: $F(4, 116)=1.29$, $P=0.27$
2st Analysis: Two-way ANOVA (between group factor-GROUP; two levels: HC vs. PD ON within group factor RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
GROUP: $F(1, 29)=13.32$, $P=0.001$
REC.SEG: $F(4, 116)=15.45$, $P<0.001$
GROUP X REC.SEG: $F(4, 116)=2.12$, $P=0.08$
3rd Analysis: Two-way ANOVA (within group factors THERAPY; two levels: PD OFF vs. PD ON & RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
THERAPY: $F(1, 13)=10.75$, $P=0.005$
REC.SEG: $F(4, 52)=9.90$, $P<0.001$
THERAPY X REC. SEG: $F(4, 52)=0.84$, $P=0.50$

FIGURE 3



1st Analysis: Two-way ANOVA (between group factor-GROUP; two levels: HC vs. PD OFF; within group factor RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
GROUP: $F(1, 29)=11.94$, $P=0.01$
REC.SEGMENT: $F(4, 116)=45.37$, $P<0.001$
GROUP X REC.SEG: $F(4, 116)=1.04$, $P=0.38$
2st Analysis: Two-way ANOVA (between group factor-GROUP; two levels: HC vs. PD ON within group factor RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
GROUP: $F(1, 29)=3.04$, $P=0.09$
REC.SEG: $F(4, 116)=47.93$, $P<0.001$
GROUP X REC.SEG: $F(4, 116)=0.42$, $P=0.78$
3rd Analysis: Two-way ANOVA (within group factors THERAPY; two levels: PD OFF vs. PD ON & RECORDING SEGMENT: five levels 1st, 2nd, 3rd,4th, and 5th)
THERAPY: $F(1, 13)=21.98$, $P<0.001$
REC.SEG: $F(4, 52)=26.27$, $P<0.001$
THERAPY X REC. SEG: $F(4, 52)=5.20$, $P=0.01$

Conclusions: The study provides novel information on repetitive finger movement kinematics in PD patients and indicates that reduced amplitude and velocity are the most relevant abnormalities in the early stage of the disease, whereas a significant performance decrement is likely a feature of the advanced stage of PD. The kinematic analysis of repetitive finger movement provides an accurate assessment of pharmacological therapies.

Major references:

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