

SPEECH AND VOICE DISORDERS IN EARLY UNTREATED PARKINSON'S DISEASE

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BACKGROUND and AIMS

The term hypokinetic dysarthria (HD) is in use to describe characteristic disorder of speech corresponding to cardinal motor symptoms of Parkinson's disease (PD). HD relates to restriction in range, speed and regularity of orofacial movements, and to deficits in respiration, phonation and phonetics. Although a 70-90% occurrence of HD has been estimated in advanced PD [1-3], it is unclear whether HD is present since early stages of PD. The aim of the present study was to identify symptoms of HD in patients with early untreated PD.

PATIENTS

We studied 17 male patients with early PD [mean age 63.4 (±SD 11.3, range 34-82); mean duration of PD 2.3 (±1.4, range 0.75-6.83 years), Hoehn and Yahr stage 1-2, UPDRS III mean 18.4 (±7.2, range 5-32)], before starting symptomatic pharmacotherapy. 16 healthy male controls (HC) of comparable age served as controls.

METHODS

All patients were examined by a speech therapist using a modified version of Dysarthric Profile 3F (DP3F) including 89 items composed from 5 points rating scales measuring faciokinesia, phonorespiration and phonetics [4]. HC were examined with the same tasks except faciokinesia. All examinations were video-recorded using Panasonic NV-GS 180 camera with external microphone.

For evaluation of phonation and phonetics, individual recordings were broken up into segments corresponding to successive analysis items and were assessed by a speech therapist in blinded fashion and random order.

Acoustic analysis

In Box 1, see the items of DP3F which were subsequently processed with acoustic analysis (AA). The fundamental frequency (or pitch of vocal oscillations) was calculated as standard deviation of semitone pitch period variation obtained from speech signals. The measures jitter, shimmer, and noise to harmonic ratio (NHR) were computed using the software package Praat.

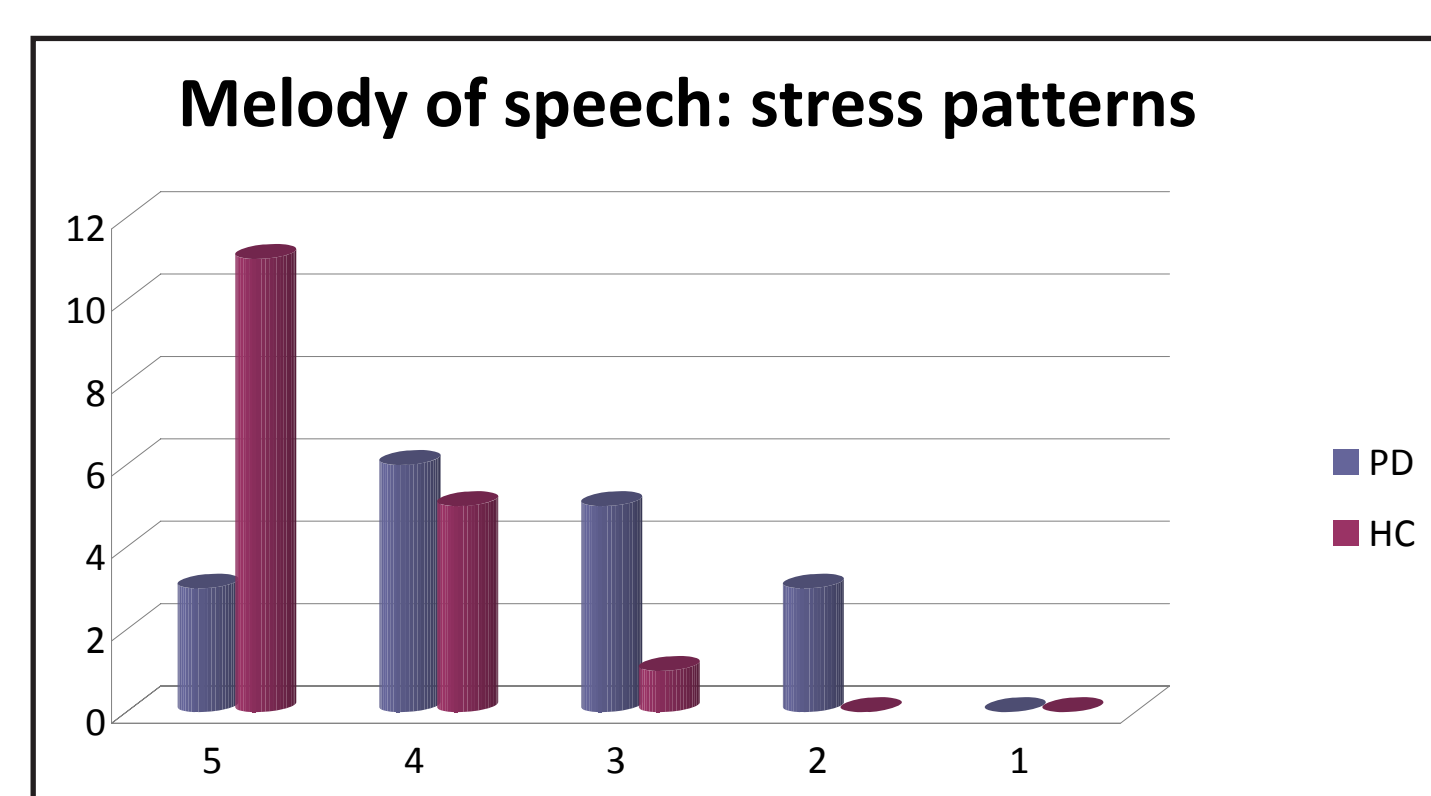
Two-sided Wilcoxon rank-sum test was used to compare the results of AA in PD and HC. Pearson product moment correlation was done to ascertain the relationship between DP3F scores and AA results.

Table 1. Dysarthric profil 3F – results of clinical evaluation

	PD		HC	
	Number	Percentage	Number	Percentage
Hypomimia	15	88.2%	0	0%
Hoarse voice in sustained /iii/	16	94.1%	8	50%
Slower rate of DDK /pa-ta-ka/	15	88.2%	6	37.5%
Irregular rate of DDK /pa-ta-ka/	9	52.9%	5	31.3%
Inability to maintain appropriate rhythm	14	82.4%	4	25%
Reduced melody of speech in:				
interrogative sentence	11	64.7%	8	50%
imperative sentence	16	94.1%	4	25%
stress patterns	14	82.4%	5	31.3%
emotional sentences	17	100%	6	37.5%
reading text	15	88.2%	5	31.3%
monologue	15	88.2%	1	6.3%

The figures represent absolute number and percentage of subjects presenting respective signs. DDK: diadochokinesia

Figure 1. Ability to imitate stress patterns.



Melody of speech in patients with Parkinson's disease (PD) compared with healthy controls (HC). X axis represents DP3F rating scale scores: 5 points= intact performance; 1 point= absent melody of speech. Y axis represents number of subjects.

Table 3. Correlations between clinical evaluation (DP3F) of recordings and acoustic analysis results, in all PD and HC subjects

Items	PD		HC		p
	Mean	SD	Mean	SD	
Sustained /iii/					
Jitter [%]	0.9435	0.7870	0.3173	0.3167	p < 0.01
Shimmer [%]	7.3548	3.9758	2.5847	1.7691	p < 0.001
NHR [-]	0.2089	0.2901	0.0214	0.0282	p < 0.001
DDK /pa-ta-ka/					
Rate [syll/s]	6.2839	0.5120	7.0114	0.7522	p < 0.01
Regularity [-]	0.7726	0.5086	0.7704	0.3848	p = 0.68
Rhythmical text					
Rhythm [-]	2.7612e-004	5.0849e-005	2.2079e-004	2.9133e-005	p < 0.001
Interrogative sentence					
F0 variations [st]	7.6042	1.8036	10.5789	2.9555	p < 0.01
Imperative sentence					
F0 variations [st]	7.2599	2.3947	12.8238	3.4925	p < 0.001
Stress patterns					
F0 variations [st]	1.8581	0.6565	2.4438	0.5021	p < 0.01
Emotional sentences					
F0 variations [st]	2.4065	0.6611	3.8129	0.7926	p < 0.001
Reading text					
F0 variations [st]	1.4001	0.5413	2.1176	0.5099	p < 0.001
Monologue					
F0 variations [st]	1.1988	0.2486	2.2500	0.7975	p < 0.001

NHR: noise to harmonic ratio; DDK: diadochokinesia in repeating syllables /pa-ta-ka/, rate measured in syllables per second; Melody of speech: fundamental frequency (F0) measured in semitones (st).

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RESULTS

Dysarthric profile 3F – clinical evaluation:

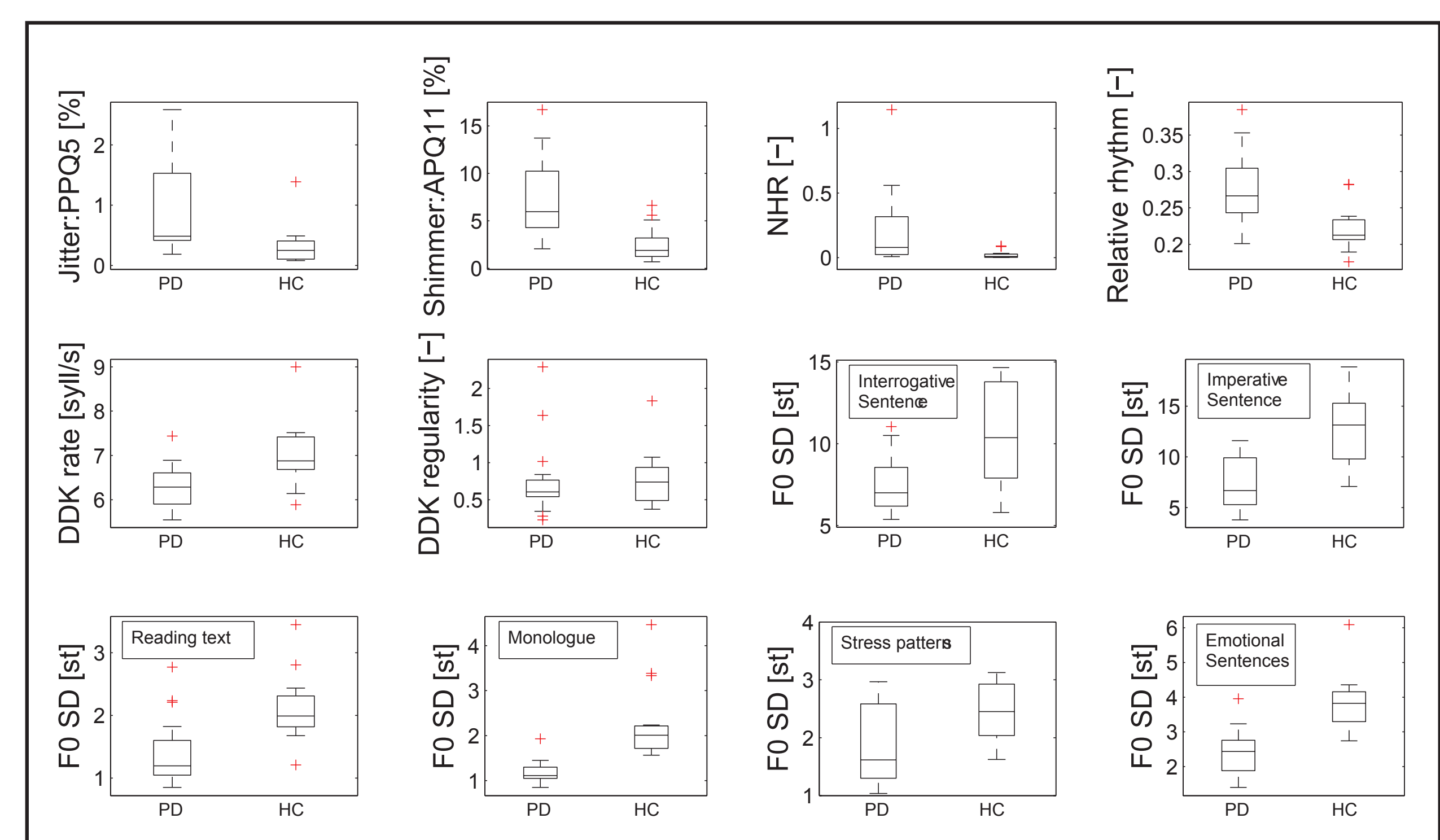
12 out of 17 PD patients and none of HC fulfilled the criteria of HD. Individual signs of HD were found in the majority of PD patients (Table 1, Figure 1). Hypomimia, hoarse voice in sustained vowels and reduced melody of speech were the most frequent signs of HD in PD group.

Acoustic analysis

AA discovered significantly worse performances of PD patients compared to HC, in tasks focused on phonation of sustained vowel /i/, on ability to maintain appropriate rhythm and on melody of speech (Table 2, Figures 2,3).

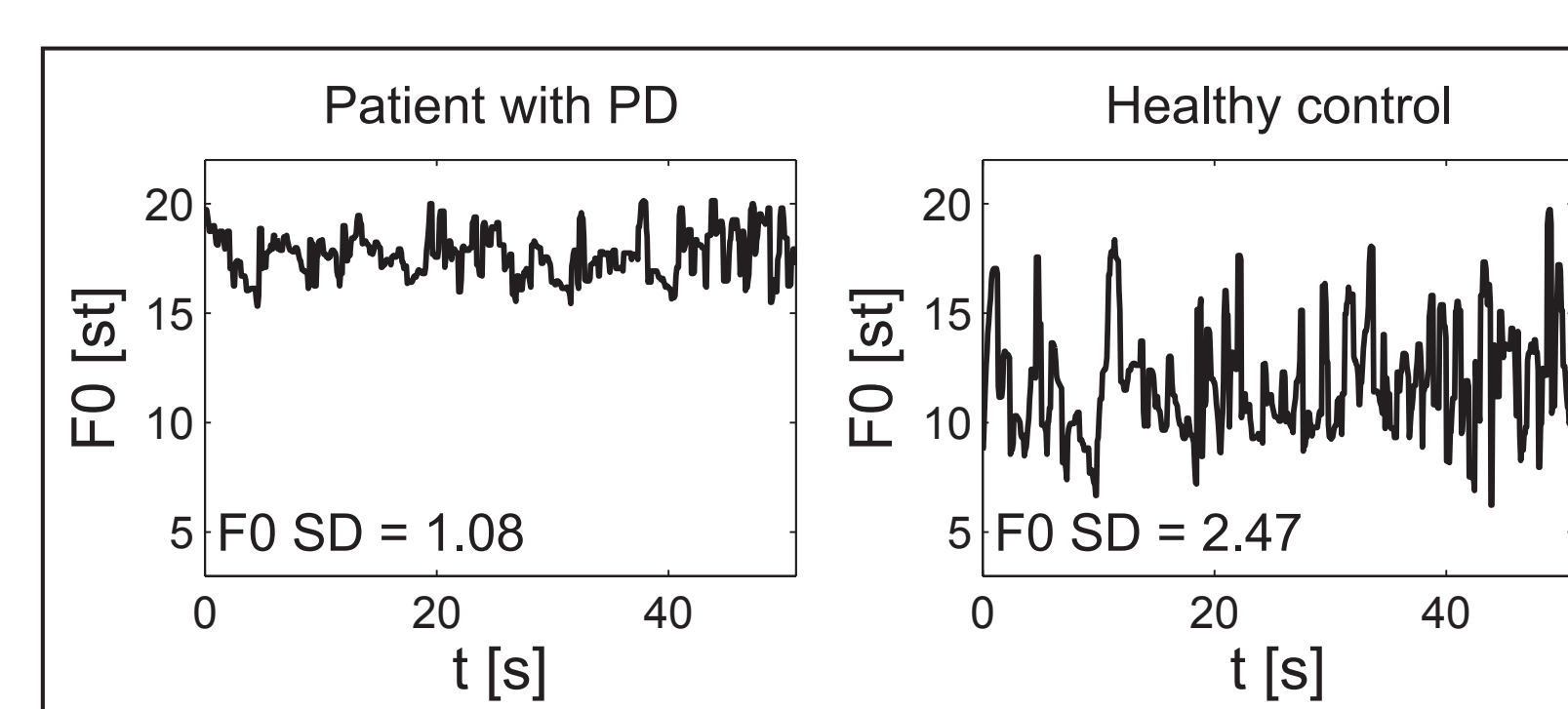
The results of AA closely correlated with DP3F evaluation of recordings (Table 3).

Figure 2. Results of acoustic analysis (single parameters)



NHR: noise to harmonic ratio; DDK: diadochokinesia in repeating syllables /pa-ta-ka/, rate measured in syllables per second; Melody of speech: fundamental frequency (F0) measured in semitones (st)

Figure 3. Melody of speech in monologue in PD patients and in HC



X axis represents time in seconds; Y axis represents fundamental frequency F0 measured in semitones (st).

Box 1. Items of clinical evaluation that were processed with acoustic analysis

- Ability to sustain /iii/
- Ability to repeat /pa-ta-ka/ rapidly (diadochokinesia)
- Ability to maintain appropriate rhythm
- Ability to maintain appropriate intonation in imperative sentence
- Ability to maintain appropriate intonation in interrogative sentence
- Ability to imitate stress patterns
- Ability to maintain appropriate intonation in emotional sentences
- Melody of speech in text reading
- Melody of speech in monologue

CONCLUSIONS

- Most of patients with early untreated PD show symptoms of HD.
- Hypomimia, hoarse voice in phonation of vowels and reduced melody of speech are the most frequent symptoms of HD in early stage of PD.
- Acoustic analysis confirms the results of clinical evaluation.

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