Developing a new home monitoring device for dyskinesia in Parkinson's disease

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Objective: To evaluate how accurately a new device can discriminate different clinical severities of dyskinesia from non-dyskinetic movements in patients with Parkinson's disease (PD).

Background: PD dyskinesia is a leading cause of falls and unplanned hospital admissions and leads to reduced quality of life (QOL). It may occur unpredictably and frequently throughout the course of a day, making it difficult for patients to report their symptoms in detail. Furthermore, not all patients are aware of their own dyskinesia. New methods for objectively monitoring dyskinesia over 24 hours at home would enable clinicians and patients to make informed decisions on drug management.

Methods: 23 PD patients wore small electromagnetic movement sensors on their limbs, head and trunk so their movement data could be continuously recorded onto a mobile phone (see Figs 1 & 2). They were video-recorded and clinically assessed every hour using the UPDRS and UDysRS. The first 6 patients TRAIN had 7 assessments and the next 17 patients TEST had 3 assessments. The TRAIN movement sensor data and clinical ratings were used to develop a computer program called a 'classifier' that discriminates different severities of dyskinesia. The classifier was developed using purpose written computer evolutionary algorithms. The accuracy of the classifier was then evaluated on the previously unseen TEST movement sensor data.

Table 1: Summary of demographics and clinical assessments

	TRAIN	TEST
Number of patients	6	17
Assessment period in hours	6	2
Gender male:female	4:2	11:6
Age in years	71 (8.9)	65 (7.3)
PD disease duration in years	9.8 (3.7)	8.1 (3.6)
UPDRS part 3 (motor) score	31 (19.1)	28 (18.0)
UDysRS score	33 (31.0)	28.8 (29.5)
PDYS - 26 QOL score	37.6 (29.2)	34.7 (24.5)
Number of movement data points for each UDysRS grade:		
0	2933	1747
1	1227	971
2	1688	562
3	681	183
4	64	361

Results are presented as the mean (standard deviation) except where otherwise stated.

Figure 1: Small lightweight movement sensors are used

Figure 2: Movement sensors are easily attached using Velcro straps and may be worn under or over clothing

Results: Table 1 shows that the patients in the TRAIN and TEST data sets were broadly similar, although the TRAIN patients were slightly older and their motor and dyskinesia scores more severe. The classifier trained on the first data set generalised well when tested on the second data set, achieving useful levels of sensitivity/specificity when distinguishing samples with UDysRS levels 3 (0.85/0.78) and 4 (0.90/0.84) from samples with no dyskinesia; see Figures 3A and 3B.

Figures 3A & 3B: The diagnostic accuracy at different grades of dyskinesia severity

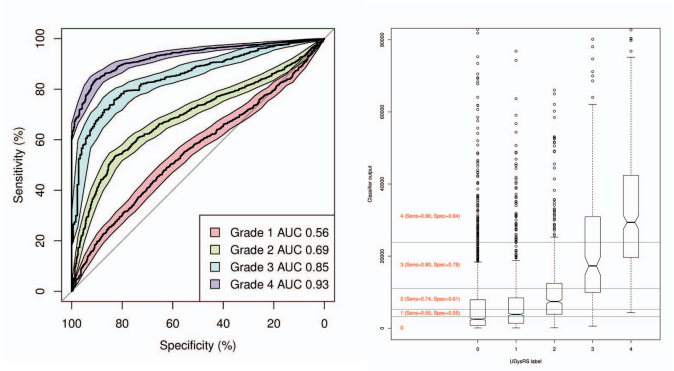
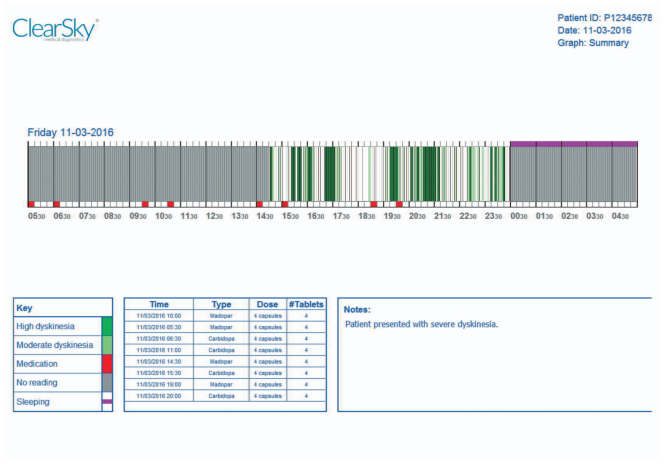


Figure 4: Example of a clinical report from a 10 hour recording period



Conclusions: This technology shows promise for development into a useful home-monitoring device that can objectively measure dyskinesia; see Figure 4. It has the potential to enable better management of dyskinesia and hence improve QOL, reduce unplanned hospital admissions and reduce medical costs.

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