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New Long-term Evaluation of Parkinson's Disease Gait

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Objective

This study aimed to quantitatively measure the pathological gait of Parkinson's patients using a foot pressure sensor for a long-term, to confirm the possibility of the use in clinical care and to use it as a basic data for developing a footwear-based activity tracker.

Subjects and Methods

Two patients with Parkinson's disease participated in the study (Table 1). The gait ability of the patients were measured with walking course that included straight lines and turns on a self-paced for 300 seconds in the medication "On" state. Excepting when the FOG is triggered, It was evaluated that stride time, step time, step time, stance time, force, pressure and area in gait measures. The number of FOG and time of FOG in FOG measures were detected from the collected data based on force-time integral data for 300 seconds. The assessment was measured by Pedar®-X(Novel GmbH, Munich, Germany). Calories per minute were also measured during walking by using portable cardiopulmonary metabolic system (Cosmed K4B2, Rome, Italy).

Result

Long-term quantitative measurements of two Parkinson's patients showed a decrease in distance and velocity, increase of stance time (8%, 7%) and decrease of swing time (13%, 10%). Additionally, gait initiation duration was shown as 0.78s, 0.1s and number of FOG was 8 times, 4 times and time of FOG was 138.6s, 25.8s in each of Parkinson's disease patients during a 300 second recording. Other variables showed different results depending on patients. (Table 2).

Conclusion

In this study, the gait ability, number of FOG, and time of FOG with Parkinson's disease patients were measured by using a foot pressure sensor for a long-term. These data could be used to analyze the pathological gait more quantitatively than short-term visual analysis for outpatient at clinical care. In further studies, it is necessary to evaluate data from a large number of patients with Parkinson's disease and stroke. We propose the necessity of a footwear-based activity tracker to quantitatively measure long-term pathological gait in daily life.

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Table 1. Characteristics of Patients

	Parkinson's Disease	
	Case 1	Case 2
Age (year)	74	64
Sex	male	male
Height (cm)	173.5	144.9
Weight (kg)	71.6	53.6
Body mass index (kg/m^2)	23.8	22.5
Shoe Size (mm)	260	240
Hoehn & Yahr score		
"On" medication	3	2

Table 1. Characteristics of patients

Table 2. Gait measures and FOG measures

	Parkinson's Disease	
	Case 1	Case 2
Number of Steps (n)	453	300
Time (s)	300	300
Distance (m)	139.2	208.8
Energy Expenditure (kcal/min)	2.8	5.7
Velocity (m/s)	0.46	0.70
Stride Time (s)	1.31	1.07
Stance Time (%)	65	64
Swing Time (%)	35	36
Mean Maximum Force (kgf) / Bodyweight (kgf)	8.1	9.0
Maximum Pressure (kPa)	120	138
Mean Pressure (kPa)	64	73
Area (cm^2)	133	99
Gait Initiation Duration (s)	0.78	0.10
Number of FOG (n)	8	4
Time of FOG (s)	138.6	25.8

FOG, Freezing Of Gait.

Table 2. Gait measures and FOG measures

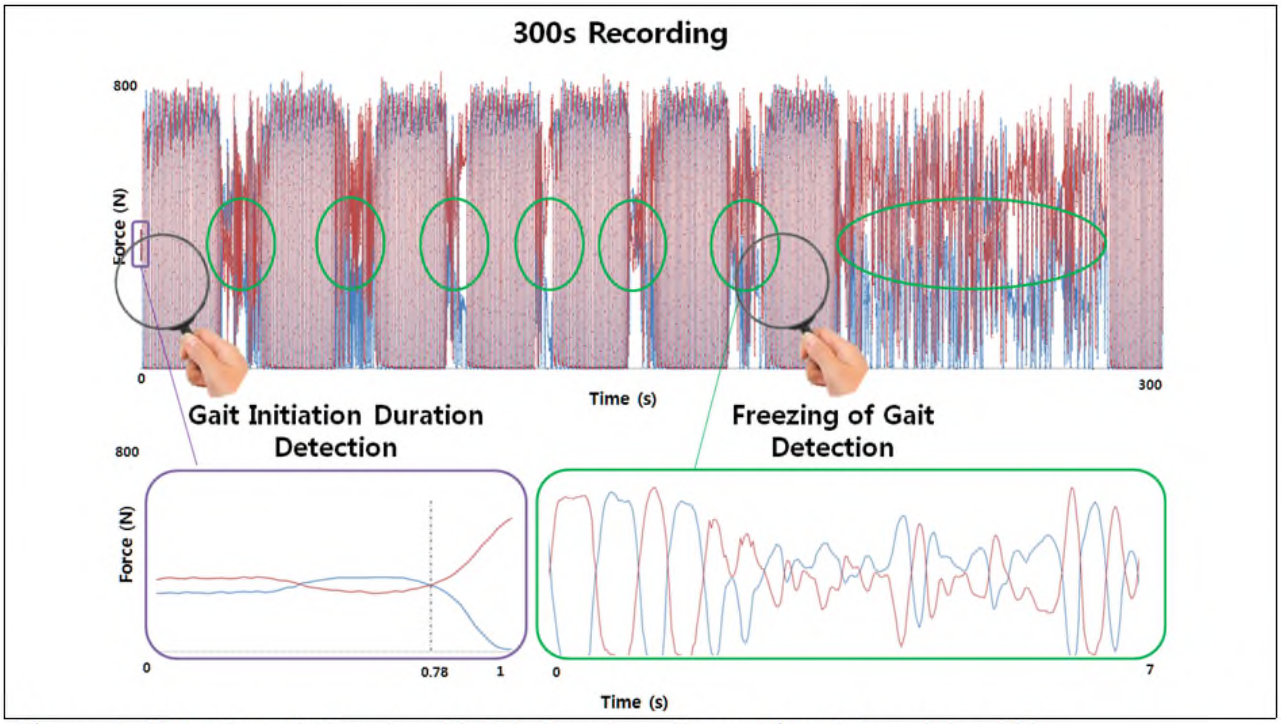

Figure 1. Detection of Freezing Of Gait Based on Force Time Integral for 300s

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