Continuous monitoring of turning mobility in patients with Alzheimer's disease: A pilot study

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Scholarly Concentration in Medical Technology, Innovation, and Entrepreneurship

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Introduction

Patients with Alzheimer's Disease (AD) frequently have impaired spatial navigation. These deficits in spatial cognition are thought to contribute to the increased risk of falls and wandering, both of which can be highly morbid conditions. Recent studies using continuous activity monitoring in cognitively normal older adults revealed that reduced spatial cognitive skills were associated with decreased turning mobility. The aim of this study was to investigate the preliminary feasibility of continuous monitoring of turning mobility in patients with AD. The broader goal was to develop an objective measure of spatial cognitive skills in these patients.

Methods

We recruited 6 patients with AD, ages 67 to 85 years of age, to take part in this study conducted at the Alzheimer's Disease Research Center, Johns Hopkins University, Baltimore, Maryland. Each patient wore an *Opal sensor* (*APDM Wearable Technologies*, Portland, OR) on a belt on their lower back during normal daily activity and were instructed to wear the device for 4 consecutive days. We used an algorithm to identify periods of walking from the 3D accelerations (>10 sec) and calculated the following turning metrics that occurred while walking: number of turns occurring in each 30-minute period; turn angle amplitudes; turn durations; and turn velocities (mean and peak).

Results

We successfully recorded data from all 6 patients [mean age 77.3 years, 67% male, Mini-Mental State Examination (MMSE) scores from 14 to 28] (Table 1). The number of days of sensor use ranged from 2 to 5 days, and the number of hours of use ranged from a total of 16.5 to 45.5 hours. Data about specific turning mobility were generated for all 6 patients. When compared to data from healthy older adults, the only quantity that differed significantly for the patients with AD was mean turn angle. Mean turn angle was larger in the older healthy adults than in the patients with AD (96° versus 75°) (Table 2).

Conclusion

In this pilot study, patients with AD tolerated the *Opal* continuous monitoring device and provided valuable data on turning mobility. Even the patients with the lowest MMSE scores (lowest was 14) tolerated wearing the device. The next steps of this study are to recruit additional subjects to complete a total of 25 (similar) patients and evaluate whether turning mobility is associated with MMSE scores and spatial cognition in patients with AD.

Table 1: Demographic Characteristics

Patient No.	Diagnosis	Age	Sex	MMSE
1	VD	77	M	21
2	AD	79	M	28
3	AD	85	M	14
4	LBD	69	M	27
5	MCI	67	F	25
6	AD	69	F	20

VD: Vascular Dementia; **AD:** Late Onset Alzheimer's Disease
LBD: Lewy Body Dementia; **MCI:** Mild Cognitive Impairment
MMSE: Mini–Mental State Examination

Table 2: Turning Characteristics

Patient No.	No. Hours	No. Turns	Mean Turn-Duration (s)	Mean Peak Speed (degrees/s)	Mean Turn-Angle (degrees)
1	45.5	478	2.53	63.57	83.53
2	16.5	156	1.86	69.31	68.20
3	33.5	122	1.56	112.84	82.29
4	28.5	67	2.45	61.18	68.33
5	42.0	2250	2.24	80.82	102.46
6	21.0	280	2.0	103.7	97.5
HF	67.7	4401	2.18	74.00	96.00
SF	67.7	3791	2.25	72.00	95.00
RF	67.7	3114	2.50	68.00	93.00

HF: Healthy Non Fallers; **SF:** Single Fallers; **RF**: Recurrent Fallers