

Background

Few studies assess the objective ambulatory function and mobility of patients with chronic disease. Studies have shown diabetes increases the risk of falls, which is associated with poor ambulatory performance.¹ Our study aimed to assess the baseline ambulatory function of patients at our tertiary wound care center by means of objective kinematic gait analysis and determine whether the prevalence of diabetes and diabetic neuropathy were correlated with altered gait mechanics.

Methods

Adult patients who could safely ambulate unassisted, without pain, without an open wound, and without lower extremity surgical intervention within the last three months were approached for participation in our study. Gait analysis was performed and evaluated using wearable Opal sensors (APDM, Portland, OR).

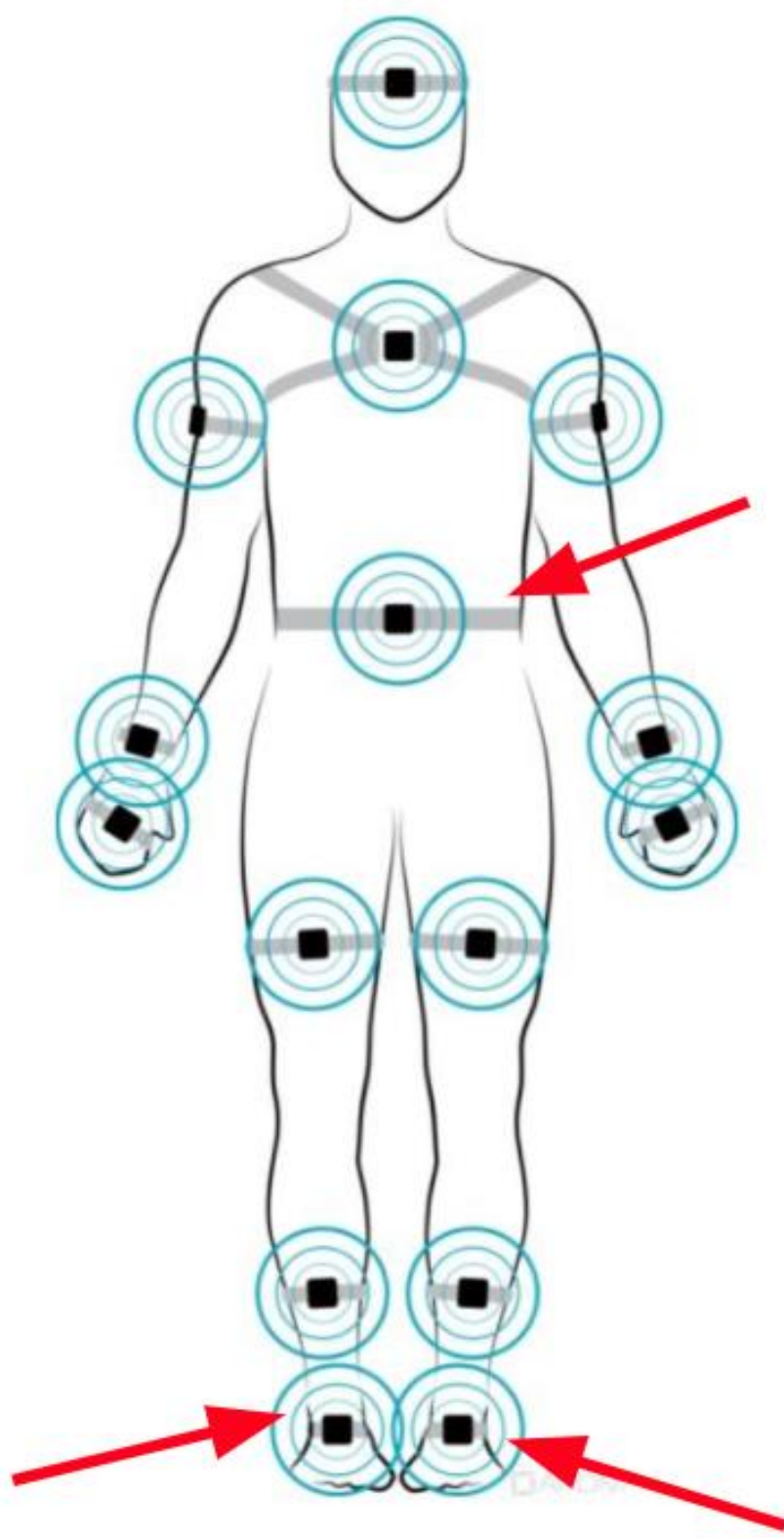


Image Source: APDM Wearable Sensors

Gait analysis included both a standardized 60-second walk test, assessing gait speed, mid-swing elevation, and step duration, as well as a 30-second balance (sway) test to assess postural stability. Each patient was prompted in a regulated fashion. Chart review was performed to collect pertinent demographic, medical, and surgical history data.

Results

Thirty-nine patients were recruited and elected to participate in our study. Patients were an average of 61.4 years old (SD: 13.0 years) and had a median Charlson Comorbidity Index (CCI) of 4 (IQR: 2-5). Twenty-eight patients (71.8%) had diabetes, 23 of which had diabetic neuropathy (59.0% of total study population). Sixteen patients (41.0%) had a history of major lower extremity surgery, such as free tissue transfer, or amputation. Two patients (5.1%) had a history of Charcot arthropathy. Diabetic neuropathy was predictive of reduced gait speed ($\beta=-0.166$, $p=0.021$), increased height of foot swing ($\beta=0.731$, $p=0.019$), and increased postural sway ($\beta=0.073$, $p=0.025$). Decreased gait speed was also correlated with age, comorbidity, diabetes, chronic kidney disease, and Charcot (Table 1). Major surgery to the lower extremity, including amputation, was correlated with increased postural sway ($p=0.045$).

Table 1: Gait Parameters Compared to Patient Demographics, Comorbidities, and Surgical History

	Overall	Gait Speed (m/s)	p-value	Elevation Mid-Swing (cm)	p-value	Step Duration (s)	p-value	RMS Sway (m/s2)	p-value
Patients	39	0.88 +/-0.22	-	1.33 (0.76, 1.88)*	-	0.60 (0.56, 0.67)*	-	0.13 (0.08, 0.18)*	-
Age (years)	61.4 +/-13.0	** β = -0.007	0.013	β = -0.008	0.450	β = 0.001	0.557	β = 0.004	0.112
CCI	4 (2, 5)*	** β = -0.041	0.031	β = 0.113	0.135	β = 0.003	0.700	β = 0.005	0.780
Diabetes	28 (71.8%)	0.83 +/-0.20	0.023	1.46 (1.04, 2.32)	0.070	0.61 (0.56, 0.67)	0.111	0.13 (0.08, 0.22)	0.134
Neuropathy	23 (59.0%)	0.81 +/-0.20	0.021	1.52 (1.13, 2.45)	0.019	0.62 (0.56, 0.68)	0.104	0.15 (0.10, 0.35)	0.025
CKD	9 (23.1%)	0.73 +/-0.17	0.022	1.40 (1.18, 2.67)	0.317	0.64 (0.59, 0.70)	0.106	0.16 (0.12, 0.42)	0.124
Charcot	2 (5.1%)	0.55 +/-0.15	0.031	1.38 (0.34, 2.43)	0.702	0.76 (0.76, 0.77)	0.036	0.49 (0.10, 0.87)	0.396
Any surgery	16 (41.0%)	0.81 +/- 0.22	0.080	1.81 (0.85, 2.93)	0.189	0.63 (0.57, 0.69)	0.104	0.16 (0.10, 0.38)	0.049
RMS - root mean squared, CCI - Charlson Comorbidity Index (calculated), CKD - chronic kidney disease *continuous variables that did not follow a normal distribution are denoted as: median (Q1,Q3), p-values were assessed by two-sample Wilcoxon rank-sum (Mann-Whitney) test. **beta coefficient (β) denotes the degree of change the outcome for one unit increase in the predictor variable, negative β values indicate an average decrease in the outcome variable									

Conclusion

Our results demonstrate that patients with diabetic neuropathy have altered gait mechanics, decreased postural stability, and decreased ambulatory function compared to nondiabetic patients. Further studies are needed to correlate these findings with surgical outcomes, profile-matched healthy patients, and to assess whether gait kinematics are a reliable predictor of long-term fall risk in neuropathic patients. Assessing the gait mechanics in patients with diabetes, with peripheral neuropathy, with prior lower extremity wound or intervention, or those currently receiving lower extremity wound care may be a promising, objective measure to better stratify a patient's risk for poorer outcomes and identify the need for appropriately selected and timed interventions.

References:

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