

Smartphone app may prevent dangerous freezing of gait in Parkinson's patients

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Immunohistochemistry for alpha-synuclein showing positive staining (brown) of an intraneural Lewy-body in the Substantia nigra in Parkinson's disease. Credit: Wikipedia

Many patients in the latter stage of Parkinson's disease are at high risk of

dangerous, sometimes fatal, falls. One major reason is the disabling symptom referred to as Freezing of Gait (FoG)—brief episodes of an inability to step forward that typically occurs during gait initiation or when turning while walking. Patients who experience FoG often lose their independence, which has a direct effect on their already degenerating quality of life. In the absence of effective pharmacological therapies for FoG, technology-based solutions to alleviate the symptom and prolong the patients' ability to live independently are desperately being sought.

CuPID is a project three years in the making and the product of an eight-member European Union-funded consortium including researchers at Tel Aviv University. It strives to provide personalized rehabilitation for patients with Parkinson's disease who experience FoG or other gait disturbances. CuPID is a home-based, personalized rehabilitation tool in the form of a [smartphone app](#) that harnesses wearable sensors, audio biofeedback, and external cueing to provide intense motivational training tailored to each patient. The results are monitored remotely by medical professionals, who provide quality care while enhancing patient compliance.

The CuPID app just completed its pilot run and is being fine-tuned for more widespread use. It utilizes small sensors placed on a patients' shoes that measure a person's gait in "real-time." If certain deviations from a pre-set norm emerge, an audio message alerts the patient to change his or her walking pattern immediately to avoid a dangerous situation.

"FoG is a leading cause of disability in patients with Parkinson's disease," said professor Jeffrey Hausdorff of TAU's Sackler Faculty of Medicine and the Center for Movement, Cognition, and Mobility at Tel Aviv Sourasky Medical Center (TASMC). Hausdorff is the lead investigator on the Israeli team. "It often occurs during 'walking transitions' associated with turning, starting, stopping, and moving in

open spaces. It can also occur when people approach narrow spaces, such as doors or elevators, and in crowded places. Recognizing such situations is a very powerful key for prevention—and this is one of the features of this program."

Hausdorff and his team at Tel Aviv Medical Center conducted a pilot study on 40 subjects: 20 patients with Parkinson's disease who used the CuPid app and 20 patients who carried out conventional exercises and did not use the app. The results are promising and the investigators are currently exploring the possibility of a larger follow-up study to further demonstrate the app's efficacy.

Repairing a "short circuit"

Dr. Anat Mirelman, also of TAU and TASMC, co-directed the project. She explained that FoG episodes resemble a short circuit in the brain, rendering it unable to generate the appropriate stepping pattern, often leaving the patient in an untenable and frustrating situation. The app is designed to circumvent that difficulty.

"There are two modes to the app," said Mirelman. "The first improves the overall gait pattern—'keep it up, you are walking well,' says a virtual physical therapist—and the positive feedback while walking actually helps the patient emotionally as well as functionally. If the gait pattern needs adjustments, the app will let the user know. The second mode helps patients avoid and free themselves of FoG if they are already stuck. We believe, and we have already seen in clinical trials here at the hospital, that this has the potential to improve the quality of life for these patients quite dramatically.

"FoG reduces [patients'](#) independence. Patients become afraid of walking by themselves and this leads to self-imposed restrictions in mobility," Mirelman continued. "When their feet get stuck to the ground, their

bodies lunge forward—it's very frightening. People often end up in wheelchairs, and this is a vicious cycle, as it places more reliance on the assisted-living infrastructure."

"The program now integrates the expertise of a patient's physical therapist, who establishes what is considered a patient's 'normal' or 'strong' walking pattern," said Hausdorff. "It's unobtrusive and has the potential to reduce dependence on Parkinson's medication that has detrimental side effects. How much or how often the app is used depends on how advanced the disease is, but since the system is so small and non-invasive, it can be used just about anywhere. It's exciting to think of the potential of long-term use."

Provided by Tel Aviv University

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