Vibrating Insoles Improved Balance

Insoles may have implications for patients with Parkinson's disease and multiple sclerosis.

REVIEWED BY JAMES J. COLLINS, MD

Vibrating insoles can improve balance in patients who have diabetic neuropathy and stroke, according to Boston University researchers. James J. Collins, PhD, and colleagues reported in the *Annals of Neurology* that subsensory mechanical noise applied to the soles of the feet appears to "tickle" the neurons, making them more sensitive to stimuli that are present when patients are standing.

Somatosensory function declines in patients suffering from diabetic neuropathy (and sometimes in stroke), resulting in diminished motor performance. Clinically referred to as sensory anataxia, afflicted patients will experience postural instability when they attempt to stand quietly with their eyes closed.

Previous studies have shown that input noise can enhance human sensorimotor function, according to Dr. Collins.

"Noise can enhance the detection and transmission of weak signals in sensory systems via a mechanism known as stochastic resonance," he said in the report. "The phenomenon of stochastic resonance, which is counterintuitive given that noise traditionally has been viewed as a detriment to signal detection and system performance, is based on the concept that the flow of information through a system can be maximized by the presence of a particular nonzero level of noise."

Dr. Collins and colleagues examined whether subsensory mechanical noise applied to the soles of the feet via vibrating insoles improved quiet standing balance control. The cohort included 15 patients with diabetic neuropathy and 15 with stroke.

The neuropathy group included nine women, three patients with type 1 diabetes, and the age range was 38 to 81 years with a mean age of 60 ±11 years. Among the stroke group, there were 10 women, the age range of the patients was 31 to 90 years and the mean age was 61 ±17 years. The mean time following stroke was 5.5 ±3.3 years.

The investigators included sway data from 12 healthy elderly individuals for comparison.

The diabetes patients were evaluated for moderate peripheral neuropathy using a vibration detection threshold test with a biothesiometer. A score in the range of 20 V to 40 V identified patients who had moderate peripheral neuropathy, according to the American Diabetes Association.

"We chose the score as our main selection criterion because it tests the function of large fibers, the same fibers that are involved in sensory ataxia," the investigators wrote.

The mean vibration detection threshold score was 28 ±13 V on the left foot and 27 ±5 V on the right. Diabetes patients were excluded from the study if they had foot ulcerations, custom orthotics, stroke, a history of a neuropathic condition other than diabetes or a positive Romberg test as indicated by the inability to maintain a standing position with their eyes closed for 30 seconds.

Patients in this study were fitted with two insoles molded with a viscoelastic silicone gel. Each sole had three vibrating elements called "tactors" (C-2; Engineering Acoustics, Winter Park, Fla) embedded in the insole to propagate vibrations to the plantar foot surface. Dr. Collins wrote that each insole received the same noise signal.

The investigators looked at five traditional sway parameters and three derived from random walk analysis. Application of noise resulted in a statistically significant reduction in each of the eight sway parameters in all patients.

"We also found that higher levels of baseline postural sway in sensory-impaired individuals was correlated with greater improvements in balance control with input noise," Dr. Collins said.

This study constitutes the first steps toward assessing the clinical significance of using vibrating insoles to improve balance control in patients with sensory deficits, the researchers concluded. ■

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Priplata AA, Patritti BL, Niemi JB, et al. Noise-enhanced balance control in patients with diabetes and patients with stroke. *Ann Neurol.* 2006;59:4-12.