A wearable device to assist individuals with the rare genetic condition PIEZO2-LOF

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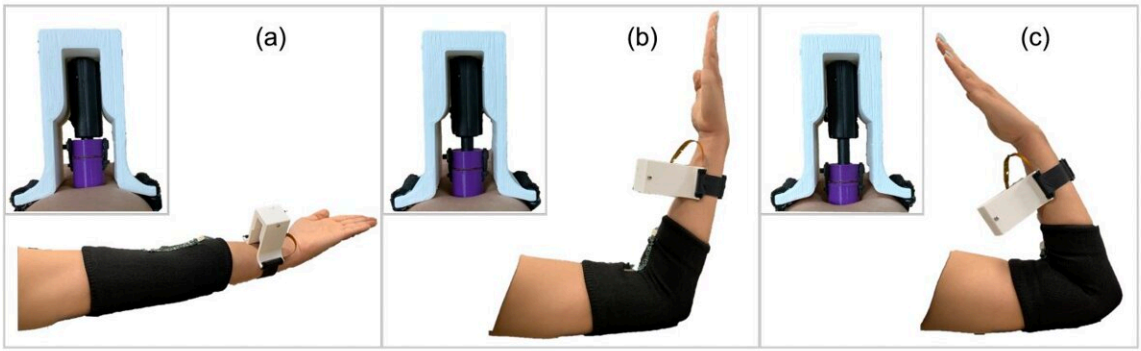

Fig. 1. Prototype device with elbow angle measurement and tactor mounted on the forearm. As elbow angle becomes more acute, the tactor provides increased pressure.

Credit: Kodali et al. (2022)

The Piezo-type mechanosensitive ion channel component 2, or PIEZO2, is a protein coding gene that has been linked to mechanically-activated (MA) cation channels, which connect mechanical forces to biological signals. The PIEZO2 encoded protein can quickly adapt MA currents in somatosensory neurons, which are responsible for processing sensory information.

Loss of function (LOF) mutations in the PIEZO2 gene can lead to a rare genetic condition associated with impairments in the functioning of

somatosensory neurons. It also results in an absence of proprioception (i.e., the perception or awareness of one's own body position and movements) and light touch.

People affected by this rare genetic condition find completing functional tasks, such as walking and manipulating objects, very difficult. Although it can be highly impairing, so far there are no treatments or assistive technologies specifically designed for PIEZO-2 LOF.

A team of researchers at Stanford University and National Institutes of Health (NIH) have recently developed the first wearable haptic device that could help individuals affected by this rare condition to complete everyday tasks. This device, presented in a paper pre-published on arXiv, is designed to sense stimuli in the environment and then communicate proprioceptive information back to users.

"There are no pharmacological treatments or assistive technologies available for individuals with PIEZO2-LOF," the researchers wrote in their paper. "We propose a sensory substitution device that communicates proprioceptive feedback via detectable haptic stimuli."

Deep pressure sensations, such as those that one might feel when someone is hugging them, squeezing their hand, or grabbing their arm, are intact in people with PIEZO2-LOF. Sreela Kodali and her colleagues at Stanford and NIH decided to leverage this when creating their device.

To wear this new device, users need to fasten it around one of their arms using wide hook-and-loop straps integrated on the device. As they move, the device will translate information related to the angle at which their elbow is positioned into deep pressure stimuli, which are then applied to the user's forearm.

"We created a wearable prototype that maps measurements of elbow

movement to deep pressure applied to the forearm," the researchers explained in their paper. "The prototype applies up to 18 N, includes an embedded force sensor, and is programmable to allow for various angle-to-pressure mappings."

The device created by Kodali and her colleagues is currently a prototype; thus, considerable time is likely to pass before it is made available to the public. Nonetheless, once it is, it could truly help individuals with PIEZO2-LOF to lead more functional lives.

"Our future work will include comparing proprioceptive acuity and movement ability and movement ability with and without the device in healthy and PIEZO2-LOF individuals, developing low-profile devices using soft robotics, providing sensory substitution for multiple joints simultaneously and encoding additional aspects of joint dynamics," the researchers wrote in their paper.

More information: Wearable haptic device for individuals with congenital absence of proprioception. arXiv: 2206.08930 [cs.HC]. arxiv.org/abs/2206.08930

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