New clinical research will test brain's ability to adapt to advanced bionic limbs

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A new, first-of-its-kind clinical trial will examine how the brain adapts to advanced, bionic arms in children born without a limb, with the ultimate goal of improving children's control of their prosthetic.

The work, which starts this spring, will be led by Limbitless Solutions, a nonprofit, direct support organization at the University of Central Florida, Wolfson Children's Hospital of Jacksonville and Nemours Children's Health, Jacksonville. The joint effort brings together expertise from pediatric research, neuroradiology, and bionics.

Approximately four babies in every 10,000 are born missing a limb, according to the U.S. Centers for Disease Control and Prevention. Prosthetics can be a supportive tool for children to perform everyday activities, but little is known about how the brain responds to the addition of an artificial limb.

"Limited research has been conducted on how the brain's motor cortex structure changes from congenital limb loss and subsequent use of a prosthetic," says Albert Manero, executive director and co-founder of Limbitless Solutions.

The four-month clinical trial will examine if Limbitless' prosthetic—paired with its custom training video game—will impact the motor control center of the brain. Researchers will closely monitor any changes in the signals the brain sends to the muscle groups that direct the bionics' movement.

They will do this using advanced functional magnetic resonance imaging techniques before and after prosthetic use and training. Additionally, researchers will use a method known as tractography—where MRI scans visualize the nerve pathways—to identify new or more robust pathways resulting from the training.

The study is unique because it combines advanced imaging techniques with novel prosthetics and video-game-based training to evaluate motor cortex engagement.

"It may provide new insight to how the brain's motor cortex adapts to learning how to use our organic, or robotic, limbs," Manero says.

Manero will lead the research study on the Limbitless side as the investigator along with other UCF staff and faculty. Chetan Shah, MD, chair of radiology at Nemours Children's Health, Jacksonville, Florida, and based at Wolfson Children's Hospital of Jacksonville, will lead the imaging work.

"This research will help us see how the brain responds to the child's newly acquired ability to use a prosthetic hand," Dr. Shah says. "This is a novel way of using existing brain circuits to use an artificial limb, and most importantly, this is a life-changing device for a child both mentally and physically. We are extremely enthusiastic about this research."

Limbitless Solutions, which Manero co-founded as a graduate student at UCF along with John Sparkman and Dominique Courbin, specializes in developing advanced, muscle-based biosensing technology, such as bionic limbs, to increase accessibility and empower children and adults in the limb-different community.

The customized prosthetics they create are 3D printed and can be paired with a parent's smart phone. The devices even charge like a cell phone,

via USB type C.

The exteriors of the devices are artistically designed and customized, with input from each participant. Existing muscles in the residual part of a limb are used to control their function, which is triggered by a person's own muscle flex.

In 2016, Limbitless and faculty members Matt Dombrowski with UCF's School of Visual Arts and Design and Peter Smith with UCF's Nicholson School of Communication and Media created video games to train children's muscles in anticipation of receiving bionic arms. These video games will be leveraged in the trial to support training for the use of the prosthetic limb.

Limbitless Solutions believes no person with a limb difference should be financially burdened to have a bionic arm and plans to provide prosthetics and training systems for the study free of charge.

Provided by University of Central Florida