UC San Diego
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New Tools at UC San Diego Help Calibrate Doses for 'Exercise as Medicine'

San Diego, June 15, 2017 — Similarly to prescribing pharmaceuticals, prescribing "exercise as medicine" is not a one-size-fits-all endeavor. Physical therapists must know what exercise to prescribe to whom, and in what 'dosages.'

EPARC's new Biodex system 4 uses specialized attachments to isolate multiple joint angles to test functional capacity—"every joint down to a finger."

Two new tools in the Exercise and Physical Activity Research Center at the University of California San Diego Qualcomm Institute will help exercise physiologists understand – in potentially only one session – how much and what type of exercise to suggest to patients who are experiencing physiological difficulties, from minor issues with walking to those with acute injuries such as Traumatic Brain Injury and concussion or neurological disease like Parkinson's Disease.

Patients with Parkinson's Disease, for example, often experience areas of impaired neuromuscular integration that, when compounded with muscular weakness or imbalance, can lead to an increased fall risk. Many movements can become even more difficult for Parkinson's patients when they are medicated. However, studies have shown that certain exercises can mitigate the negative effects of neuromuscular diseases like Parkinson's and lead to increased capability to perform activities of daily life.

EPARC's new Biodex system 4 uses specialized attachments to isolate multiple joint angles to test functional capacity – "every joint down to a finger," says EPARC Laboratory Director David Wing. It measures a whole range of motion in multiple joints in both isometric mode (i.e.

unmoving force as if someone were pushing against a wall) or isokinetic mode (i.e. force throughout the range of motion at a given speed). The goal is to pinpoint specific areas of weakness through the entire range of motion for a specific activity, such as throwing a ball or steering a car.

A second new tool in the EPARC lab is the C-Mill, a 12-foot-long treadmill capable of projecting virtual targets and obstacles into a person's path as s/he walks to monitor ability to readjust gait to avoid obstacles or negotiate uneven terrain. (Wing notes that many falls happen when people are walking.) The C-Mill also records key gait measurements such as stride length and width, impact forces (i.e. how much weight the walker strikes the ground with), and what part of the foot is the center of the impact.

"These tools really round out EPARC's capabilities to test all of the different components of exercise as it relates to health," says Wing. "Prior to now, we really were contributing to research in terms of aerobic health and standing balance, and we were using field-based tests for strength and balance during movement. The Biodex gives us the capability to fully quantify the strength component of health, and the C-mill gives us the ability to monitor dynamic balance in real time to visualize how an individual is actually moving in order to understand (and prevent) the potential causes of falls."

Biodex: Creating a Personalized Rx for Exercise

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The Biodex, which is located in EPARC's facilities on the third floor of Atkinson Hall, is being made available for service agreement with researchers both on and off-campus for either diagnostic or experimental research.

"The Biodex helps us identify areas of weakness or left-right imbalances, or how much strength has been lost as a result of an injury, like a leg break," says Wing. "If it's at the top of the range of motion that you are weakest, for example, you want to train for that, not for the middle of the range where you are already strong. The Biodex helps us make sure you're not doing squats when what you need is lunges. You can see how it would also be useful for premiere athletes or for people recovering from injuries."

Best of all, getting accurate measurements with the Biodex typically only requires one session – an improvement on former methods for measuring neuromuscular imbalances, which required patients to perform a number of sometimes grueling physical trials.

“There are a lot of challenges to lifting things even for a healthy person, and risk of fatigue after you do it multiple times, which prevents us from getting a measurement of true maximal capacity,” adds Wing. “What the Biodex allows us to do is in a single trial get accurate numbers in a non-invasive way.”

The Biodex is already being used for experimental research at UC San Diego. A team led by Dr. Francisco Villarreal, an adjunct professor in the School of Medicine, is examining whether or not supplementation with epicatichen – a flavanoid in dark chocolate – affects mitochondrial function, a critical component of aerobic health and muscular endurance. The Biodex will be used before and after supplementation to test for muscular power and endurance.

C-Mill: Shedding Light on Gait Disturbances

The C-Mill, which is located in the QI Smart Home space on the first floor of Atkinson Hall, is a long treadmill designed for walking, with a maximum speed of six miles per hour. The machine integrates kinematic data (synced to a visual recording) with data gathered from a force-plate underneath the machine’s tread, which measures the amount of force being used to walk. Not only can it measure deterioration in gait capability over time, the C-Mill is also capable of projecting light images onto the tread to simulate obstacles in a person’s path.

“(In other testing scenarios) if we want to test a Parkinson’s patient or stroke patient and we put an obstacle in their path and they hit it, it will hurt them. With the C-Mill the obstacles are made of light and can’t do any damage, although they can tell us a lot about gait,” explains Wing.

“Part of what we’re kind of excited about, though, is taking what the C-Mill does and applying it to new things,” he continues. “At EPARC we know how to do the tried-and-true assessments, and we do them very well. But, what we pride ourselves on is taking tools and applying their capabilities in new and exciting ways.”

Wing says he hopes researchers in the QI-based Contextual Robotics Lab will also use treadmill, “perhaps to see if robots can identify and avoid obstacles, which has possibilities for machine learning,” he added. “Certainly the seed is there.”

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