CASESTUDY

“SMALL STUDIES” YIELD BIG FINDINGS

Department of Exercise Science - University of South Carolina

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Sometimes you've got to sort through the small stuff to get a better look at the big picture. At least that's how Dr. Matt Kostek, HFS, sees things at the University of South Carolina's Laboratory of Muscle and Translational Therapeutics.

"That's exactly what we do here," explains Kostek, who has a PhD in kinesiology, post-doctoral training in molecular genetics, and serves as the lab's director. "Our lab work relates to understanding the molecular mechanisms of muscle rehabilitation and their application to a human context. We undertake several kinds of experiments each day, tackling everything from basic cell culture and individual muscle action all the way up to working with human participants in our research. By examining muscles at the molecular level, we hope to get a more accurate read of how rehabilitation protocols and different modalities help patients to heal."

Although the thought of looking at things from a molecular standpoint may sound like tedious work to some, Kostek and his team have had an exciting year in which they've completed three major studies and confirmed at least one important rehabilitation theory that can be of real help to doctors and therapists establishing protocols for rehabilitation patients.

It's an ambitious program that Kostek claims he couldn't accomplish without an especially talented lab crew - or the Biodex Multi-Joint System 4, which served as the cornerstone in gathering accurate, reliable, and reproducible data used to establish baselines, chart improvement and isolate even minute details within selected aspects of study parameters.

"All three of our human studies relied heavily on the Biodex System to gather data," revealed Kostek. "In fact, it would be fair to say I don't think we could have conducted these programs with lesser equipment."

Ultrasound Vs. High-Powered Laser Therapy

In one cutting edge study, the results of which were recently published in the American Journal of Sports Medicine, the lab team looked at selected molecular aspects of muscle recovery with the use of therapeutic ultrasound (TUS) and high-powered laser therapy (LiteCure, LLC). The FDA approved the latter modality only a few years ago.

In this instance, participants were instructed to perform 200 maximal eccentric contractions with the quadriceps on the Biodex Multi-Joint System to induce a very controlled light muscle strain or heavy muscle soreness. Either ultrasound or high-powered laser therapy was then applied to the "injured" muscle, with the hope of increasing energy production in the cell (adenosine triphosphate, also known as ATP) and growth factor production. Finally, muscle biopsies were performed to look at some of the molecular effects. To perform the molecular measures, the lab crew needed to know exactly what load was put on the muscle, a functional measurement at which the Biodex Multi-Joint System excels at capturing.

"The reason we used the Biodex, as opposed to a piece of more generic equipment like free weights, is to better control the study parameters such as the amount of work completed or amount of force produced at any particular angle of movement," stated Kostek. "This device allowed us to very specifically quantify the force of every contraction - and the peak torque of each contraction - to see if there was a difference in the amount of muscle strain induced in one individual over another."

Thus far it appears that TUS has been having a positive impact on improving force production, and activating the expression of growth factors within the muscle cells.

Matt Kostek, Ph.D
University of South Carolina, Department of Exercise Science

"The Biodex System really helped us from both a consistency and reliability standpoint with this study," continued Kostek, "and it also proved to be highly repeatable. We not only brought people in on subsequent days, we brought them in up to five times each for reliability testing. We also performed reliability testing between technicians and found that, when trained on the protocol with the Biodex, their reliability was very good. When you cut to the chase, this all simply boils down to having a system that gives us a lot of faith in the data collected."

Scientific Precision Is Key

In a second study, Kostek and crew examined some of the more functional aspects of ultrasound. This case followed patients for 14 days, with the participants returning every other day to be measured on the Biodex Multi-Joint System as the team looked carefully at muscle function recovery. In this instance, the findings showed that muscle functional recovery was improved and pain sensation was dampened with treatment.

"Again," explained Kostek, "the beauty of this [Biodex] system is that it provides very precise measurements. We used it to look at isometric peak torque and isokinetic work across varied speeds. That gave us a better indication and more accurate measurement of muscle function because we could measure it very precisely as compared to something like a squat exercise. Some might argue that it's a little more functional to do a squat test, but the Biodex provides much greater precision. Functional tests are sometimes too variable between people to be used in scientific research."

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Isokinetics Before Isotonics?

The most recent study completed has the Laboratory of Muscle and Translational Therapeutics lab staff quite excited as they prepare for publication. Performed in conjunction with faculty from the department's physical therapy program, this study undertook a direct comparison of isotonic and isokinetic eccentric muscle contractions as they might be used for rehabilitation purposes. According to Kostek, the study format would not have been possible without the aid of a product like the Biodex Multi-Joint System.

In this case, isotonic eccentric and isokinetic eccentric exercises on the Biodex Multi-Joint System were compared directly to explore some of the effects on muscle function during therapy. Eccentric contractions are frequently used in physical therapy and sports medicine as a means of secondary-prevention of muscle injuries, and also as treatment of pathologies such as patella tendonosis, Achilles tendonosis, hip surgery and shoulder injuries.

"Specific eccentric exercises are prescribed to rehab many injuries, and seem to work pretty well," stated Kostek, "but nobody has really looked at the difference between isokinetic and isotonic applications even though it's always isotonic that are prescribed. So, we did an in-depth comparison of the effects on muscle for the two different contraction types. We controlled for peak load and total work, and kept everything consistent so that the only variable changing was that contractions were either isotonic or isokinetic. We focused on the quadriceps because it is most often associated with some of these exercises. Again, the Biodex System was critical as it allowed us to control all extraneous variables and make measurements with great precision."

When the study was complete and Kostek and company began sifting through the data, they discovered the force velocity curve of muscle was different between the two contraction types, at least for the quadriceps. Looking through the literature, they uncovered one other report where the same idea had been suggested.

"We were able to confirm the report and show this is true in the quadriceps," Kostek stated. "In terms of what this actually means, we think it shows that isotonic eccentric contractions produce a different type of load - a much greater one - on the muscle than the isokinetic eccentric contractions. That leads us to believe isokinetic eccentric contractions should be used very early in rehabilitation therapy, while isotonic eccentric contractions may be best saved for later therapy.

"Specifically, isotonic eccentric exercise produces a greater load on the muscle at the weakest angles in a patient's range of motion," summed up Kostek. "So, we think it would be a good idea to avoid isotonic eccentric contractions with the recently injured and those just starting therapy. We agree that eccentric exercises are recommended, but it is important to note the type of eccentric exercise performed is going to be really important. By starting with isokinetics, you can put the load on the strongest angle in the ROM and still get the benefit of eccentric exercise without putting the person at risk for additional injury."

Kostek and his team are deservedly excited about these latest findings, and plan to submit them for publication in Medicine, Science, Sport and Exercise (The official Journal of the American College of Sports Medicine). Looking ahead, they plan to follow up their current research by examining different types and doses of several therapeutic modalities in the treatment of muscle injury.

"No doubt," allowed Kostek, "the Biodex System will be a big part of that research as well."

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