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Biofeedback on abnormal mechanics lowers risk for stress fractures, pain under kneecap

More than seven out of 10 runners will sustain an injury over the course of a year, many of these injuries preventable without any adverse effects on running distance or performance, according to Dr. Irene Davis, director of the Running Injury Lab at the University of Delaware, and director of Research for Drayer Physical Therapy Institute.

In earlier studies, Dr. Davis identified the specific gait mechanics associated with common injuries. Now, in a study reported at the Experimental Biology meeting in Washington, DC, she explains how she successfully retrained runners to change their faulty gaits in eight half hour sessions, reducing leg shock by 50 percent and completely eliminating pain under the kneecap.

Her Experimental Biology presentation on April 30 is part of the scientific program of the American Association of Anatomists.

In the laboratory, Dr. Davis uses sophisticated biofeedback devices and monitors, but she says she does similar - and also effective - retraining in the physical therapy clinic at the University of Delaware using basic mechanical information, mirrors and advice to listen to the sound of one's own feet hitting the ground.

The two studies underway in Dr. Davis' laboratory now are with runners who were selected for the study because they were experiencing or had been identified as high risk for one of the two most common running-related injuries: tibial stress fractures (microfractures of the lower leg bone) and patellofemoral pain syndrome (pain under the kneecap).

Each runner undergoes an analysis of their gait. Runners then come to the laboratory for two days, take a day off, return for two, until they have had eight retraining sessions on a special treadmill. The first sessions last 15 minutes, and the final ones 30 minutes. Runners are not allowed to run outside the laboratory during retraining for fear of reinforcing old gait habits.

Dr. Davis's earlier gait mechanics research had found that individuals with tibial stress fractures tend to land harder when each foot hits the ground, and in fact about half of the at-risk runners who have completed the study so far already had experienced microfractures. During their retraining sessions, the runners wore a shock measuring device on their lower legs while they ran on a tread mill. A monitor on the front of the treadmill showed the force of each footstrike measured against a line of what a normal, healthy footstrike should look like. The runners' task was to constantly adjust the force with which each of their own feet hit the ground to keep it at or below the line on the screen.

With this feedback, all runners immediately were able to modify the hardness of their footstrike to meet the desired level, but all reported that the softer footstrike level did not "feel normal." By the end of the eighth session, however, even when they were receiving relatively little feedback, all runners had adjusted the force of their footstrike by half. Furthermore, they reported that they found the new gait now felt more normal.

The runners experiencing pain under the kneecap followed the same protocol. Dr. Davis' earlier gait mechanics studies had found that individuals with kneecap pain (patellofemoral pain syndrome) demonstrate poor hip stability, hips rotating inward, causing a knock-kneed type running gait. On the laboratory treadmill, these runners watched a monitor that compared their gait, measured by markers on their legs, to a normal angular curve.

By keeping their knees apart, not letting them collapse inward, they soon were able to make the two images merge. Before retraining, the group had classified their kneecap pain from five to seven on a ten point scale, ten being the worst. In every case, after retraining, the runners reported zero pain.

A month after the retraining, during which runners had resumed their regular running schedule, they returned to the laboratory treadmill. All had retained the lessons learned.

Dr. Davis recommends that runners without access to gait analysis and biofeedback do a little of what she does in the clinic at the University of Delaware.

"For people with or at risk for stress microfractures, we ask them to listen to their footstrikes and simply make the sound softer," says Dr. Davis. "For people with pain under the kneecap, we tell them to run in place in front of a mirror and concentrate on keeping their knees apart."

In the meantime, back at the laboratory, she is continuing to recruit patients into the study. Funded by both the Department of Defense and the National Institutes for Health in the interest

of helping individuals to remain physical fit throughout their lives, the studies eventually will include 60 runners. Data reported at the Experimental Biology 2007 meeting were for five patients in each group.

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