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Efficacy Of Novel Gait Retraining In Targeting Lower-limb Kinetic Patterns And Injury Risk

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Running-related musculoskeletal injuries are common in the active adult population and can potentially be conducive to long-term functional impairment. Recent paradigm shifts have directed more attention from expediting the rehabilitation process following injury toward identifying risk factors demonstrated by healthy individuals and proactively mitigating the temporal costs of treatment.

PURPOSE: To determine the utility of a novel gait retraining program in proactively addressing kinetic and spatiotemporal running characteristics associated with increased musculoskeletal injury risk.

METHODS: Eight healthy adults were recruited for participation in 'Run with CLASS' (*C*adence, *L*ean, *A*dherence, *S*oft landing, *S*trike); a 45-minute gait retraining protocol designed to address elements of gait conducive to the development of lower-limb injury and reinforce the implementation of movement patterns designed to mitigate injury risk without sacrificing overall performance. Prior to and following a session of the retraining protocol, all acquired kinetic variables were collected as the participants ran on a treadmill while equipped with pressure-sensitive insoles to collect bilateral ground reaction force (GRF) parameters and foot strike pattern (i.e., heel vs. forefoot) and inertial measurement units affixed bilaterally to the medial aspect of the tibia to calculate cadence and bone strain derived from acceleration patterns observed at the lower leg during running.

RESULTS: Following the intervention, participants demonstrated significantly increased cadence (157.5 vs. 166.5 steps/min; p=0.001) during running. In addition, participants displayed significantly reduced GRF impulse on both the left (262.11 vs. 247.31 N.s; p=0.015) and right (261.12 vs. 245.43 N.s; p=0.027) legs during running. Moderate effect sizes corresponding to reductions in average loading rate were identified for both the left (d=0.516) and right (d=0.609) legs.

CONCLUSION: A single gait retraining session shows promising effects on modifying kinetic parameters during running to potentially diminish injury risk. Future efforts assessing the efficacy of repeated bouts of this novel protocol can potentially shed light on sustained motor relearning and the influence it may have from an epidemiological perspective.

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Modeling The Total Force At The Knee Joint During A Fatiguing Run

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Running is associated with a high incidence of injuries. Neuromuscular fatigue is considered a risk factor, suggesting that the body in a fatigued state is less able to attenuate impact forces sufficiently, which leads to overloading and injuries.

PURPOSE: To model total knee force, consisting of reaction and muscle forces, using an OpenSim model and free body diagram before and after a fatiguing run to get insight into potential overloading of the knee during running.

METHODS: 7 recreational rear-foot striking runners (3F/4M, running >10 km p/w for >1 year; uninjured < 6 months) ran on a treadmill at 103% of their average 8-km speed until perceived exhaustion. Data were obtained while running overground up and down a 10-meter runway before and after the fatigue protocol with 8 IMUs (240 Hz), reflective markers (100 Hz) and a 3D force plate (1000 Hz). Knee force of the left leg was estimated in the sagittal plane as the summation of joint reaction forces (JRF) and muscle extensor- flexor forces around the knee. JRF were derived from ground reaction forces with a lower extremity free-body diagram; muscle forces were estimated with a musculoskeletal model in OpenSim.

RESULTS: Total force inside the knee (total force tibia - femur) during stance have a tendency to increase after a fatiguing run: the maximum force on the knee increased from 21.5 ± 2.3 BW to 23 ± 2.5 BW in a fatigued state (paired t-test, p = 0.23). Main cause was the increase of maximum extensor muscular contractions (15.2 ± 1.3 BW to 16.6 ± 2.2 BW, p = 0.09) to increase overall knee load, flexor muscular contractions and JRF did not significantly change between non-fatigued and fatigued state (fig. 1).

CONCLUSIONS: Knee load in a fatigued state has a tendency to increase after a fatiguing run, which results in a repetitive increased force on the knee that can eventually lead to overloading. These results indicate that running in fatigued state may cause damage to biological tissues in and around the knee which results in injuries.

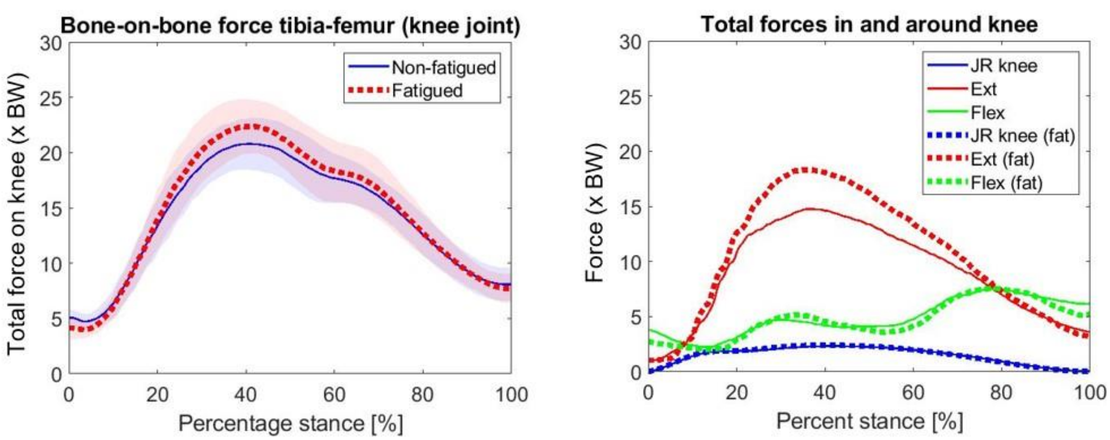

Figure 1: Left: tendency of higher total knee force in fatigued state for all subjects. Right: Example of one subject of total knee forces divided in each parameter. BW= body weight, JR = joint reaction, Ext = extensor muscles, Flex = flexor muscles, fat = fatigued state.

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Runners With Chronic Back Pain Are At Elevated Risk For Developing Chronic Knee Pain: Implications For Rehabilitation

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PURPOSE: Musculoskeletal pain often occurs in more than one site in runners. Compensatory shifting in mechanics may lead to pain elsewhere. This research determined the risk of, and potential mechanisms underlying, onset of patellofemoral knee pain (PFP) when runners initially present with low back-sacroiliac (SI) pain.

METHODS: This was a cross-sectional analysis of recreational/competitive runners who received care in the institutional running clinic (N=466; 35.5±15.1 yr; experience= 10.6yr; weekly distance=33.4km; 50.1% female; n=43 had low back-SI pain). Medical histories, clinical exam and 3D motion-kinetic analysis were performed. Logistic regression models with PFP onset as the dependent variable, and characteristics and training volumes were independent variables. Low back-SI pain presence was entered last. Univariate analyses of variance determined whether biomechanical parameters differed among runners with back-SI pain, back-PFP pain or PFP alone.