SENSORY AND ELECTROMYOGRAPHIC MAPPING OF THE QUADRICEPS WITH DELAYED ONSET MUSCLE SORENESS

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Background: The muscles of the quadriceps are characterized by different fiber pennation angles and fiber type composition. Thus, eccentric exercise may result in non-uniform structural disruption of quadriceps muscle fibers.

Aim: To investigate the spatial distribution of sensory and EMG manifestations of delayed onset muscle soreness (DOMS) in the quadriceps.

Methods: Eleven healthy, male subjects (age, mean ± SD, 24.3 ± 3.2 yr) participated in the study. Bipolar surface EMG signals were detected from the rectus femoris (RF), vastus medialis (VM) and vastus lateralis (VL) muscles with 15 pairs of electrodes. Electrode pairs were located 10%, 20%, 30%, 40% and 50% of the distance between the anterior superior iliac spine and the medial, superior and lateral border of the patella at a site bisecting 20%, 50% and 80% of the half circumference of the thigh for VM, RF and VL respectively. Pressure pain thresholds (PPTs) were assessed at the same 15 locations. A KinCom isokinetic dynamometer was used to induce DOMS of the quadriceps with a protocol of eccentric exercise. Subjects performed an isometric knee extension at 40% of the maximal force (MVC) until task failure at baseline (pre exercise), and 24 hours and 48 hours following the eccentric exercise. Average rectified value (ARV) was estimated from the EMG signals in time intervals with a duration equal to 10% of the time to task failure.

Results: Maximum knee extension force and time to task failure were reduced 24 hours and 48 hours following eccentric exercise (baseline: 438.6 ± 109.5 Nm, 24h: 316.4 ± 110.4 Nm, 48h: 300.9 ± 129.2 Nm; P < 0.0001; baseline: 56.6 ± 23.0 s, 24h: 34.3 ± 18.9 s, 48h: 34.3 ± 14.4 s; P < 0.05). Lower PPTs were recorded 24 hours and 48 hours following eccentric exercise compared to baseline (ANOVA: F = 15.42, P < 0.0001, SNK: P < 0.05), with a greater decrease in PPT identified for the distal portions of the three muscles (ANOVA: F = 15.87, P < 0.001). EMG ARV was lower 24 hours and 48 hours following eccentric exercise compared to baseline (ANOVA: F = 15.42, P < 0.0001, SNK: P < 0.05), with a greater decrease in PPT identified for the distal portions of the three muscles (ANOVA: F = 15.87, P < 0.001). EMG ARV was lower 24 hours and 48 hours post exercise with respect to baseline (ANOVA: F = 7.91, P < 0.01; SNK: P < 0.05). ARV did not change during the sustained contraction for the baseline session while it decreased over time during the contractions performed 24 and 48 hours (SNK: P < 0.05) post eccentric exercise. Moreover, at 24 and 48 hours post eccentric exercise, the relative decrease of ARV during the isometric contraction was larger for the more distal regions of each muscle compared to the proximal regions (ANOVA: F = 3.46, P < 0.00001). Thus, with DOMS the distribution of ARV over the quadriceps was more uniform at endurance compared to the beginning of the contraction.

Conclusion: Structural disruption of quadriceps muscle fibers following eccentric exercise results in non-uniform changes in PPTs and in surface EMG amplitude at the beginning of the task and with fatigue.

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