

Effects of a combined progressive resistance training and functional electrical stimulation-evoked cycling exercise on lower limb muscle strength of individuals with incomplete spinal cord injury: A randomized controlled study

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ABSTRACT

Objectives: This study was conducted to investigate the effects of combined progressive resistance training (PRT) and functional electrical stimulation-evoked leg cycling exercise (FES-LCE) on isometric peak torque and muscle volume in individuals with incomplete spinal cord injury.

Patients and methods: In the single-blind, randomized controlled trial performed between April 2015 and August 2016, 28 participants were randomized between two exercise interventions (FES-LCE+PRT and FES-LCE alone), and training was conducted over 12 weeks. The isometric muscle peak torque and muscle volume for both lower limbs were measured at the baseline and after 6 and 12 weeks. Linear mixed-model analysis of variance was performed to test the effects of FES-LCE+PRT versus FES-LCE on each outcome measure over time via an intention-to-treat analysis.

Results: Twenty-three participants (18 males, 5 females; mean age: 33.4±9.7 years; range 21 to 50 years) completed study (10 in the FES-LCE+PRT group, and 13 in the FES-LCE group). The 12-week pre- and posttraining change for left hamstrings' muscle peak torque in the FES-LCE+PRT group (mean difference=4.5±7.9 Nm, 45% change, p<0.05) was consistently higher than that in the FES-LCE group (mean difference=2.4±10.3 Nm, 4% change; p<0.018). The improvement in the right quadriceps muscle's peak torque of the FES-LCE+PRT group (mean difference=19±7.6 Nm, 31% change, p<0.05) was more significant compared to the FES-LCE group. The left muscle volume showed a remarkable increase after 12 weeks in the FES-LCE+PRT group (mean difference=0.3±9.3 L, 7% change, p<0.05).

Conclusion: The combination of PRT and FES-LCE was better in improving lower limb muscle strength and volume in chronic incomplete individuals with spinal cord injury.

Keywords: Electrical stimulation, ergometry, muscle strength, resistance training, spinal cord injuries.

Motor-incomplete spinal cord injury (SCI) is a disability that may reduce lower limb motor function and limit an individual's quality of life due

to immobility or loss of bowel and bladder control.^[1] Individuals with significant muscle disturbance below their neurological level of SCI will rapidly progress

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