Spinal direct current stimulation enhances vertical jump power in healthy adults.

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Introduction

Transcutaneous spinal direct current stimulation (tsDCS) is a simple, non-invasive tool that affects sensory, motor and spinal reflex pathways and segmental reflex activity.

Effects of spinal current stimulation in a dose-dependent manner and these effects depend on polarity: anodal DCs increase the excitability of the underlying neural structures, whereas cathodal DCs decreases it. tsDCS is considerably, with only adverse events or tissue damage reported in the literature (1).

To date, tsDCS research has focused on neurophysiological outcomes including spinal reflex behaviours and motor performance pathophysiological changes (4).

The spinal cord is the final common pathway for all motor behaviour that is mediated through ascending and descending CNS inputs to modulate and produce appropriate motor behaviour i.e. standing, running, walking or jumping (6).

In this directional activity also determines the long term neuroplastic activations associated with motor skill acquisition, sport and athletic training and the impact of the spinal reflex system (2).

It is not known whether tsDCS delivered over the lumbar spinal cord has any effect on gross motor power. In this unique study, we investigated the immediate and short term changes in up to 30 mins of sham and active anodal tsDCS on explosive vertical countermovement jump (VCJ) power and posterior root-muscle (PRM) power lower limb reflexes in healthy individuals.

We aimed to induce short term neuroplasticity in the spinal motor system and in particular VCJ power, demonstrated during explosive jumps and PRM reflex excitability. tsDCS modulation of spinal motor neuron circuits in the absence of any physical activity may have potential for rehabilitation where mobility is limited or absent. For example, after sporting or combat injury, or for neuro-rehabilitation where mobility is limited or absent, for example, after sporting or combat injury, or for neuro-rehabilitation where mobility is limited or absent.

Further work

Our laboratory is now investigating the effect of anodal tsDCS on EMG, torque and power production in isolated joint movements. We are also investigating genetic factors that may explain the variation in response to tsDCS between subjects.

Changes in PRM reflex RMS moderately correlated with changes in peak GRF shown above and absorption GFR (r = 0.421, P = 0.013 and r = 0.345, P = 0.044 respectively).

Changes in R 1–5 were also correlated with changes in GRF velocity and power (r = 0.355, P = 0.041 and r = 0.380, P = 0.023 respectively).

Changes appear to be due to alterations in self-oscillatory parameters, which could be modified comparatively, and are correlated by activity changes in reflex circuitry after sham and anodal tsDCS.

Changes in hamstring (h) and quadriceps (Q) PRM reflexes were moderately correlated with changes in peak GRF shown above and absorption GFR (r = 0.421, P = 0.013 and r = 0.345, P = 0.044 respectively).

Changes in R 1–5 were also correlated with changes in GRF velocity and power (r = 0.355, P = 0.041 and r = 0.380, P = 0.023 respectively).

Changes appear to be due to alterations in self-oscillatory parameters, which could be modified comparatively, and are correlated by activity changes in reflex circuitry after sham and anodal tsDCS.

No return to baseline values at any time post tsDCS

Mean (95% CI) change over time after sham (0) and active (1) tsDCS

Post hoc: EMG responses during VCJ

The significant difference between sham tsDCS fatigue and the tsDCS powerwork enhancement persisted without decrement over the 3 hours.

The difference in countermovement (CM) power changes from 0 to 180 mins post-DCS were not significantly different (post, P = 0.454, and average, P = 0.631).

The duration of tsDCS effect beyond the three hour test point is not known.

References


