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Seed-based functional connectivity changes and cervical motion analysis alterations in patients with cervical dystonia

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Introduction: Evaluating neck movement quality and studying the brain mechanisms underlying cervical dystonia (CD) are fundamental to plan the best treatment options.

Objective: To assess kinematic and resting-state functional connectivity (FC) characteristics in patients with CD relative to healthy controls.

Methods: Electromagnetic sensors were used to obtain spatio-temporal parameters of neck movements in CD patients and healthy controls during three tasks: repeated cervical movements, target reaching and joint position error. Mean and maximal cervical movements amplitude was measured, both with eyes open and closed. Movement quality parameters during target reaching were obtained. Joint position error parameters were registered with both eyes open and closed. The precise dystonic position was also calculated. All participants underwent resting-state functional MRI (RS-fMRI). A seed-based FC analysis with supplementary motor area (SMA) as region of interest was performed. Correlations between motion analysis parameters and FC data were assessed.

Results: Seventeen CD patients and 14 age- and sex-matched healthy controls were recruited. CD patients relative to controls showed reduced mean and maximal range of motion (ROM) in rotation both towards and against dystonia pattern and reduced total ROM in rotation both with eyes open and closed. Moreover, CD patients had less severe dystonia pattern with eyes open relative to eyes closed. The RS-fMRI analysis showed reduced FC in CD patients between SMA and bilateral occipital and cerebellar areas compared to controls. A reduced FC within the visuo-motor network correlated with a lower cervical ROM in rotation both with eyes open and closed and with a worse cervical movement quality during target reaching.

Conclusions: A FC alteration in the visuo-motor network may represent the neural basis of cervical motor control deficits in CD patients. Electromagnetic sensors and RS-fMRI might be promising tools to monitor CD and to assess the efficacy of rehabilitative interventions.