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Editorial for "Functional Reorganizations Outside the Sensorimotor Regions Following Complete Thoracolumbar Spinal Cord Injury"

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Augustus Waller published the concept of antegrade axonal degeneration following nerve injury in experimental study of frogs in 1850 (1). The concept of retrograde degeneration of spinal tracts in proximal axon and nerve cells has also been studied for many years (2). The advent of MRI and advanced imaging techniques allowed multiple studies in animals and also in human subjects. many previous publications have established extensive upstream atrophic and microstructural changes in corticospinal axons and sensorimotor cortex following acute and chronic spinal cord injury (SCI) (3).

Multiple previous studies have surmised that structural changes of the brain following SCI go beyond sensorimotor cortex and related white matter, and involve functions like cognition, vision, emotion, attention, and complex psychological processes (4). Due to impairment of sensory and motor function following SCI, brain undergoes functional reorganization, that ultimately helps it in motor function recovery. However, there have been fewer studies describing functional brain reorganization following spinal cord injury than those describing structural changes.

The current study by **** investigates whether brain undergoes extra-sensorimotor functional reorganization following complete thoracolumbar spinal cord injury (CTSCI) (5). They also investigate possible association with particular clinical manifestations and aim to provide targets for transcranial stimulation and gene chip therapy. For that they utilize resting state functional magnetic resonance imaging (RS-fMRI). They calculate the amplitude of low frequency fluctuations (ALFF) and by seed-based approach, investigate connectivity of functional brain regions for network level brain changes. 18 patients with CTSCI underwent RS-fMRI and ALFF was calculated. Cluster masks were selected per regions of significant between-group differences for performance of functional connectivity analysis. Correlation analysis was performed between the time series of seeds. Two-sample t-test between CTSCI patients and healthy controls (HC) was performed with SPM12. Partial correlation analysis explored relationships amongst the clinical scores and functional activities and the connectivity in CT SCI patients.

CTSCI patients showed decreased ALFF in the right lingual gyrus (LG), increased ALFF in the right middle frontal gyrus (MFG) and decreased functional connectivity (FC) between the right LG and Vermis_3. Subsequent correlation analyses revealed that decreased FC between the right LG and Vermis_3 positively correlated with the visual analogue scale (VAS) score. As decreased ALFF in LG is associated with depression, it can be deduced that in patients with CTSCI, it may be due to prolonged sensorimotor dysfunction. Increased ALFF in MFG, which plays an important role in sustained attention/vigilance, may be due to its compensatory role to compensate for motor dysfunction in patients with SCI.

The study characterized alterations of regional brain activities and network connectivity at resting-state in the CTSCI patients. This study shows functional brain changes in LG,

MFG and cerebellar vermis; regions associated with visual, emotion and cognition, rather than in sensorimotor cortex. The authors suggest the role of functional training with virtual reality (VR) and motor imagery (MI), and stimulation with motor-imagery-electroencephalogram (MI-EEG) in rehabilitation of patients with CTSCI.

The authors did not earlier score the patients for depression and in hindsight, missed an opportunity. A longitudinal rather than cross-sectional cohort can assess the functional and structural reorganization and its association with the chronicity of the injury. In any future studies, adding visual stimulation of cognition-based training to patient cohort can prove the hypothesis that visual, emotion and/or cognition-related training can serve as target for sensorimotor functional recovery. Early neuropsychological intervention is also proposed in a recent study to prevent associated psychological and cognitive dysfunction and irreversible structural brain damage in patients with CTSCI (6).

The findings suggest a possible theoretical basis of the mechanism of visual, emotion and/or cognition-related techniques in rehabilitation training for CTSCI and can help guide future therapies.

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References:

1. Waller AV. Experiments on the section of the Glossopharyngeal and Hypoglossal nerves of the Frog, and observations of the alterations produced thereby in the Structure of their primitive fibers. Philosophical Transactions of the Royal Society of London. 1850:140: 423–429.
2. Lassek AM. The pyramidal tract. A study of retrograde degeneration in the monkey. Arch Neurol Psychiatry 1942;48:561-567.
3. Freund P, Weiskopf N, Ashburner J, et al. MRI investigation of the sensorimotor cortex and the corticospinal tract after acute spinal cord injury: A prospective longitudinal study. The Lancet Neurology 2013; 12(9), 873-881.
4. Wrigley PJ, Gustin SM, Macey PM, et al. Anatomical changes in human motor cortex and motor pathways following complete thoracic spinal cord injury. Cerebral Cortex 2009; 19(1), 224–232.
5. **********
6. Wang WL, Li YL, Zheng MX etal. Altered topological properties of grey matter structural covariance networks in complete thoracic spinal cord injury patients: a graph theoretical network analysis. Neural Plasticity 2021; :1-9

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