

2nd International Conference on

NEUROSCIENCE, NEUROIMAGING & INTERVENTIONAL RADIOLOGY

October 30 to November 01, 2017 | San Antonio, USA

Is upper limb rehabilitation effective after tetraplegia? Responses with a meta-analysis considering classical and innovative strategies

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Cervical spinal cord injury (SCI) results in tetraplegia. SCI individuals experience dramatic somatosensory and motor deficits with related impairment corresponding to the SCI level and completeness. This severe disease concerns 40 cases per million in the USA representing approximately 12,000 new cases each year. This is associated with significant costs depending on the SCI severity ranging from 0.3 to 1 million USD for the first year (NSCISC 2012). Reaching highest autonomy as possible in daily life is conditioned by regaining upper limb function, in particular grasping capabilities. This constitutes a major concern for SCI individuals, in particular because it essentially affects young people (mean age at injury 41 years). Correspondingly, rehabilitation aims to improve hand function to promote autonomy after tetraplegia. Here, we will focus on non-invasive rehabilitation strategies usable in clinical setting. Thereby, invasive strategies including surgery fall beyond the scope of this presentation. We will separate i) “classic” rehabilitation based on a bottom-up approach relying on strengthening, use of Functional Electrical Stimulation or robotics and ii) “innovative” and more recent strategies targeting neural plasticity and aiming to restore the loop between afferent information and efferent commands. It includes top-down approach namely motor imagery alone or coupled with brain computer interfaces, virtual reality and neuromodulation mediated by transcranial direct current or magnetic stimulations (tDCS or rTMS). To date, effectiveness of upper limb rehabilitation remained narrative. We thus performed a meta-analysis of both series case studies and randomized controlled trials to address whether rehabilitation of upper limb is effective to i) reduce deficits or ii) increase hand function, and iii) alter independence. Secondly, we will sort the rehabilitation effectiveness accordingly to the classical bottom-up or innovative top-down, and neuromodulation strategies. Finally, we will conclude the presentation by formulating recommendations for rehabilitation that can be used to improve hand function after tetraplegia.

Biography

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