

Clinical applications of functional electrical stimulation in rehabilitation

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Abstract

The review investigates the objective evidence of benefits derived from surface functional electrical stimulation (FES) applied to muscle strengthening, spasticity treatment and gait training for people after complete and incomplete spinal cord injury (SCI). FES cannot be considered as functional mobility aid but can enhance general fitness in complete SCI subjects. FES can offer even more benefits in training of walking ability for people with incomplete SCI injuries. It can be efficiently combined with treadmill and body weight support. Voluntary muscle strength and endurance gain can be achieved through FES assisted gait training together with increased gait velocity. In this way, FES is competing with robotic exoskeletons. As FES is considerably less expensive and simpler to use, the expectations for broader future use of FES are realistic.

In therapeutic applications, the goal is to produce a functional benefit that lasts beyond the application of the stimulation itself. FES, particularly when applied through surface electrodes, activates both motor and sensory nerve fibers. Repetitive movement therapy mediated by FES has the potential to facilitate motor relearning either via cortical or spinal mechanisms. Regardless of spinal or cortical mechanisms, the experimental and theoretical considerations suggest that the necessary prerequisites for FES mediated relearning include repetition, novelty of activity, concurrent volitional effort, and high functional content. Biofeedback mediated FES assisted gait training, requiring greater cognitive investment, may result in greater therapeutic benefits. FES training can become an efficient exercise when combined with virtual environments. Such systems should increase the quality of training of the paralyzed extremities and as a consequence shorten the duration of treatment in the rehabilitation center. They can be through the telerehabilitation approach applied also at patients' homes immediately after they leave the rehabilitation center.