G. FERRIERO [1], R. FRISCHKNECHT [2], S. MOSLAVAC [3], T. PATERNOSTRO-SLUGA [4]

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New Frontiers in spinal cord rehabilitation

R. R. ROY, V. R. EDGERTON

In this Editorial review we will describe newly developed techniques that are being used to recover levels of motor function after a severe spinal cord injury that have not been observed previously. These new approaches include pharmacological neuromodulation and/or epidural stimulation of the spinal cord circuitries in combination with motor training. By combining the increased the levels of excitability of the interneuronal spinal circuitries using these interventions and the ability of the spinal circuitries to interpret and respond appropriately to ongoing complex ensembles of sensory input, the peripheral sensory system can become an effective source for the control of motor function. Similar types of neuromodulation have been shown to enable the brain to regain functional connectivity with the spinal cord circuitries below a clinically complete spinal cord lesion. In fact, some level of voluntary control of movement has been observed in subjects with complete paralysis in the presence of epidural stimulation. The biological mechanisms thought to underlie the recovery of motor function after a severe spinal cord injury are based on decades of research on a wide range of animal models. Fortunately the extensive conservation of neural mechanisms of motor control has provided a window for gaining considerable insight in the mechanisms of recovery of motor function in humans.

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1. **During a running exercise, one of the muscles involved develops 20% of its maximal possible force output. Approximately what proportion of its motor units is being recruited for this task?**
   A. 10%
   B. 20%
   C. 30%
   D. 40%
   E. 50%

2. **Where does the most important input for eliciting locomotor tasks at the spinal cord level originate?**
   A. Mesencephalic locomotor region (MLR)
   B. Motor cortex (gyrus preacentralis)
   C. Peripheral sensory receptors
   D. Basal ganglia
   E. Endocrine system

*Authors' names in alphabetic order
[1]Unit of Occupational Rehabilitation and Ergonomics Salvatore Maugeri Foundation, Clinica del Lavoro e della Riabilitazione, IRCCS, Scientific Institute of Veruno, Veruno, Novara, Italy
[2]Service de Neuropsychologie et de Neuroréhabilitation CHUV, Lausanne, Switzerland
[3]Spinal Unit Special Medical Rehabilitation Hospital, Varazdinske Toplice, Croatia
[4]Department of Physical Medicine and Rehabilitation, Medical University of Vienna, Vienna, Austria

3. **Epidural stimulation...**
   A. has never been used in human subjects.
   B. can enable the spinal circuitry to generate locomotor tasks.
   C. enables performance of complex tasks when applied to human subjects.
   D. has proven effective only in incomplete spinal cord lesions.
   E. should not be used in combination with pharmacologic modulation.

Use of robot assisted gait therapy in rehabilitation of patients with stroke and spinal cord injury

P. SALE, M. FRANCESCHINI, A. WALDNER, S. HESSE

Difficulty in walking is a major feature of neurological disease, and loss of mobility is the activity of daily living on which patients place the greatest value. The impact on patients is enormous, with negative ramifications on their participation in social, vocational, and recreational activities. In current clinical practice the gait restoration with robotic device is an integral part of rehabilitation program. Robot therapy involves the use of a robot exoskeleton device or end-effector device to help the patient retrain motor coordination by performing well-focused and carefully directed repetitive practice. The exoskeleton, as an assistive device, is also an external structural mechanism with joints and links corresponding to those of the human body. These robots use joint trajectories of the entire gait cycle and offer a uniform (more or less) stiff control along this trajectory. In this field the new powered exoskeleton ReWalk (Argo Medical Technologies Ltd) was developed to have an alternative mobility solution to the wheelchair and rehabilitation treatment for individuals with severe walking impairments, enabling them to stand, walk, ascend/descent stairs and more. The end-effector-based robot is a device with footplates placed on a double crank and rocker gear system. Alternatives to powered exoskeletons are devices that use movable footplates to which the patient's feet are attached. All devices include some form of body weight support. Prominent goals in the field include: developing implementable technologies that can be easily used by patients, therapists, and clinicians; enhancing the efficacy of clinician's therapies and increasing the ease of activities in the daily lives of patients.

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1. **Robotic gait training in spinal cord injured persons...**
   A. is a contraindication.
   B. is considered to be effective, with a high level of evidence.
   C. increases the muscular limb activity during exercise when compared to traditional assisted treadmill training.
   D. improves the autonomic control of blood pressure.
   E. is more cost effective than other locomotor training approaches.

2. **Considering the published evidence regarding robotic gait training, in stroke patients...:**
   A. there is a good level of evidence that robotic gait training improves daily living competencies.
   B. robotic gait training is less effective than conventional training in increasing walking ability.
   C. the effectiveness of robotic gait training is well established.
   D. at 1 year after stroke robotic gait training is no longer effective.
   E. robotic gait training fails to improve muscle force.

3. **For gait training it is of utmost importance...:**
   A. to walk fast with a natural gait similar to that of over-ground gait.
   B to walk slowly with a natural gait similar to over-ground gait.
   C to walk repetitively with a natural gait similar to over-ground gait.
   D to walk independently with a natural gait similar to over-ground gait.
   E to walk with assistance with a natural gait similar to over-ground gait.

See answers on page 173.