Letter to the Editor

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Facilitation of ambulatory function in SCI patients by training and electrical stimulation

In the paper of Herman *et al*¹ an interesting case of a patient suffering a spinal cord injury (ASIA C) is described whose ambulatory function was improved by combining treadmill training followed by epidural spinal cord stimulation. In the future such a combination of training followed by electrical stimulation of afferent fibres might have a beneficial effect in a greater number of patients with SCI.

In contrast to the statement given in the paper¹ several reports have described that functional ambulation can be achieved in early^{2,3} as well as late⁴ chronic, wheelchair-bound patients suffering a severe SCI (ASIA C) by a systematic treadmill training alone. Unfortunately, the duration and intensity of the training, which is known to play an essential role for the achievement of an ambulatory function in ASIA C-patients was not indicated in the report. In our cases the improvement of locomotor function took place with a training usually lasting over about 30 min, 5 days per week, and over a period of more than 4 months.³ Recently, it was described that the effect of such a locomotor training can probably further be enhanced by the application of a robotic training device, the 'Locomat'.⁵

In respect to the facilitation of ambulatory function by electrical stimulation of afferent nerve fibres, several approaches exist and were applied in patients with SCI (for review see⁶). I acknowledge the positive effects achieved by the authors in the case report.¹ However, why an epidural stimulation? A quite elegant and more physiological way to activate motoneuron pools underlying locomotion is to activate peripheral flexor reflex afferents (FRA), for example, by electrical stimulation of the peroneal nerves, using surface electrodes, in the respective phases of the locomotor cycle.^{7,8} The flexor reflex represents part of the neuronal circuits underlying locomotion. Therefore, it seems to be a more 'natural' way for activating spinal neuronal circuits. For example, stepping-like movements with reciprocal activation of leg flexors and extensors could be released in a complete paraplegic patient by long-lasting electrical impulse trains applied by surface electrodes.¹⁰ Habituation of the flexor reflex during locomotion can be minimised.^{7,8} Furthermore, strong flexor reflex responses can be elicited, especially in patients with cervical spinal cord lesions.¹¹

In the case presented¹ it would have been an advantage to first evaluate the effect of such a non-invasive approach of stimulation and, if still of interest, to compare the effects with those obtained by epidural spinal cord stimulation. Unfortunately, no EMG records from leg muscle activity during locomotion with and without electrical stimulation were provided in the report.¹ Such an approach would be essential to evaluate and differentiate the effects obtained by training³ and those by electrical stimulation. By such an

evaluation unspecific training effects on muscles and ligaments might also become separated. For specifying the most effective approaches and their combinations biomechanical and electrophysiological recordings would be most helpful for future studies on locomotor function in patients with SCI.

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