

What makes neurorehabilitation successful?

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Alicante, Summerschool
on Neurorehabilitation
16th-19th September 2013



Spinal Cord Injury Center
Balgrist University Hospital
Zurich

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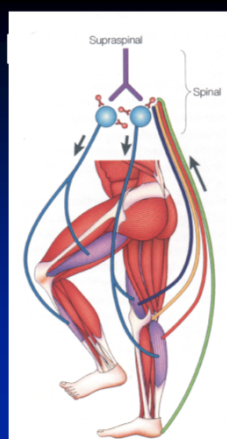
Factors influencing training effects:

- Appropriate proprioceptive input: physiological muscle activation
- Spastic muscle tone
- Task-dependent functional neuronal coupling:
 - locomotion
 - cooperative hand movements

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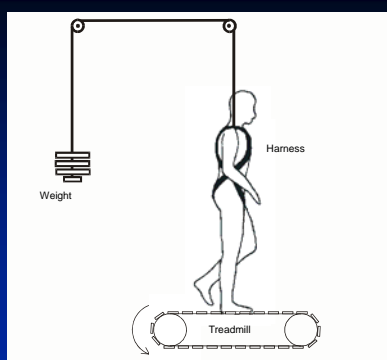


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Dietz, Nature Rev Neurosci 2002

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Complete traumatic paraplegia T3
ASIA A

Male, 67 y

4 months post injury

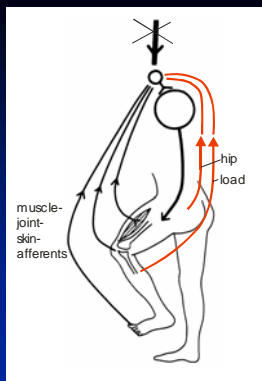
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Adaptation of leg muscle EMG to body weight unloading (BWS)

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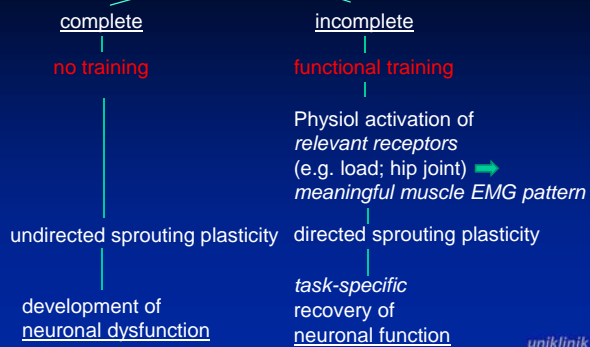


Lokomat Pro

We move you

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Spinal Cord Injury

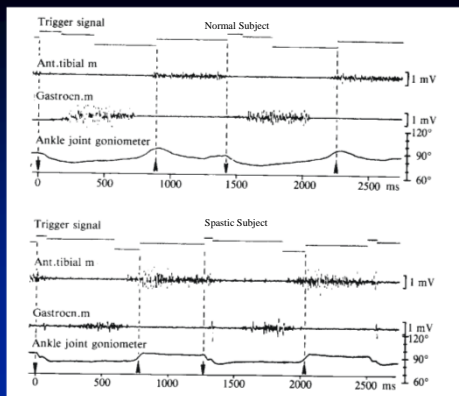


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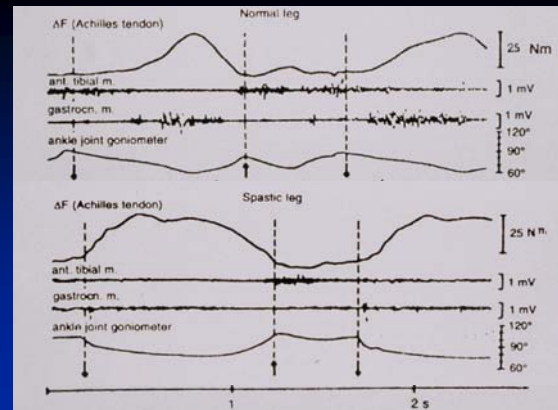
Factors influencing training effects:

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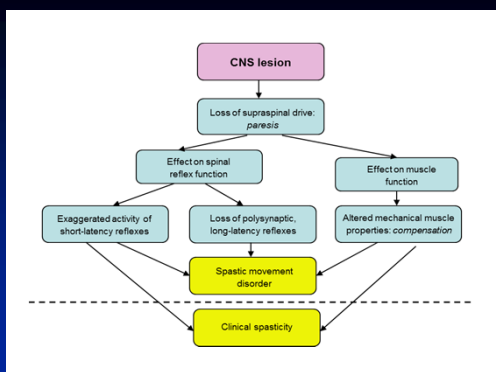
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Dietz & Sinkjaer, Lancet Neurol 2007

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Consequences for rehabilitation

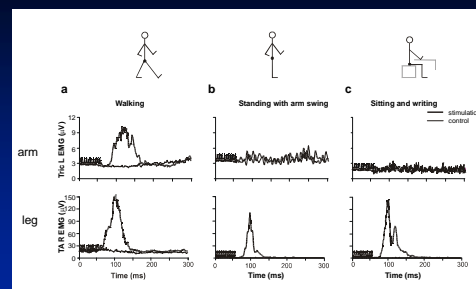
- Spastic muscle tone is required to compensate for paresis, i.e. loss of muscle activation
- Improvement of function is associated with reduced muscle tone

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Factors influencing training effects:

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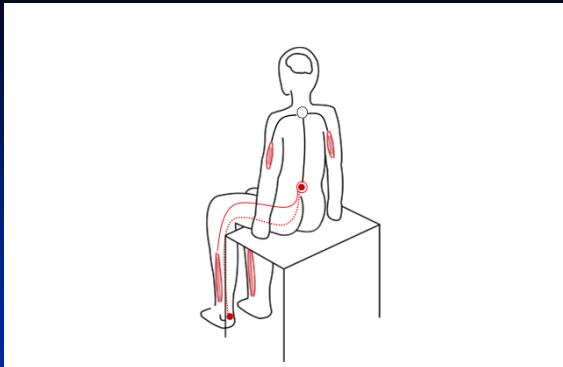
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Dietz et al. 2001, Eur J. Neurosci

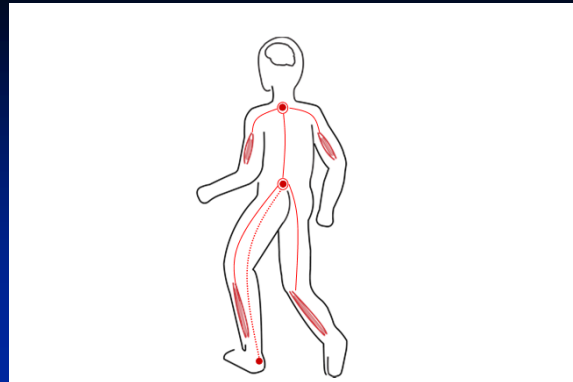
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Sitting



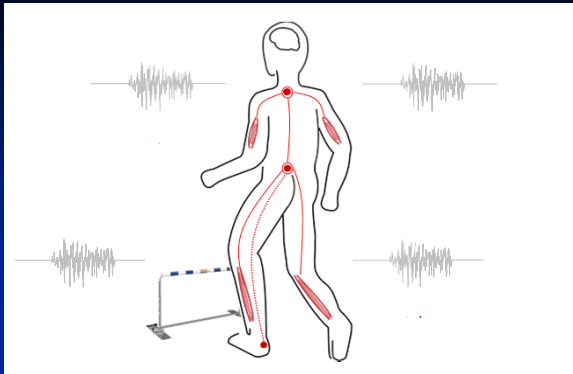
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Walking

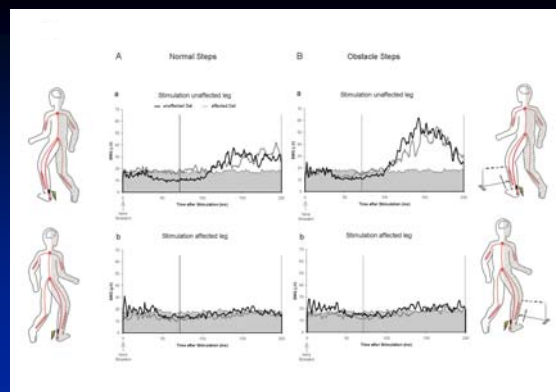


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Obstacle avoidance



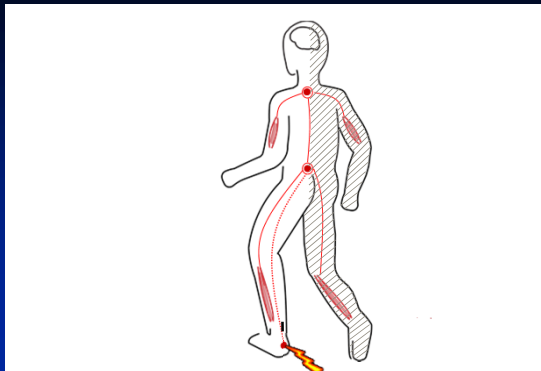
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Kloter, Wirz, Dietz; Brain 2010

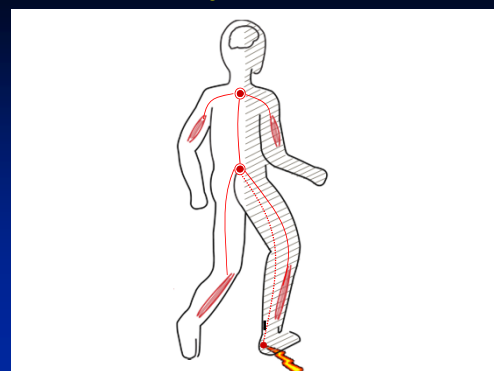
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Stroke subjects: Walking-stimulation unaffected leg



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Stroke subjects: Walking-stimulation affected leg



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Consequences for gait rehabilitation

- Stimulation of the unaffected side enhances activity of paretic muscles
- Body unloading prevents neural coupling: loss of interaction between arm and leg muscle activation

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Factors influencing training effects:

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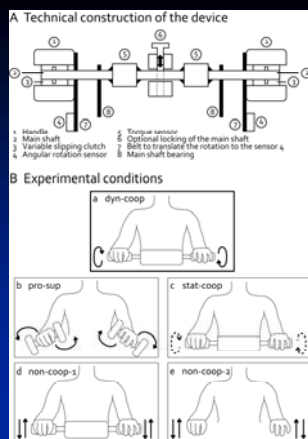
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Reach and grasp movements

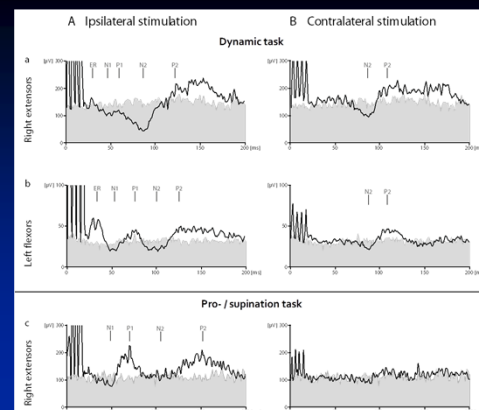
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Cooperative hand movements

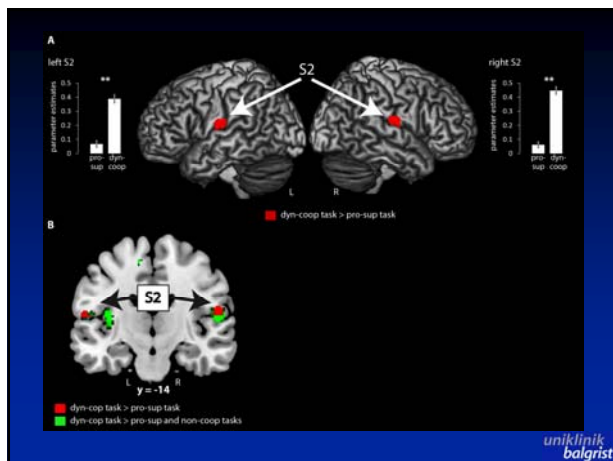
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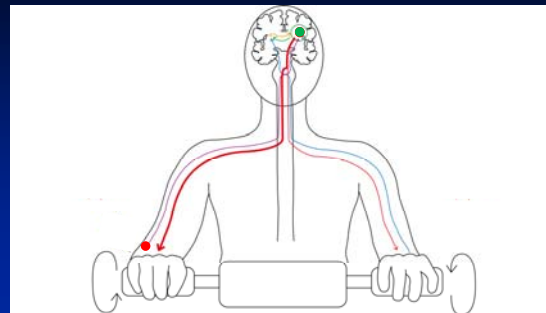
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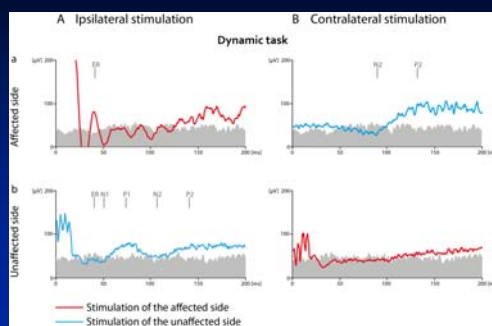


Cooperative hand movements

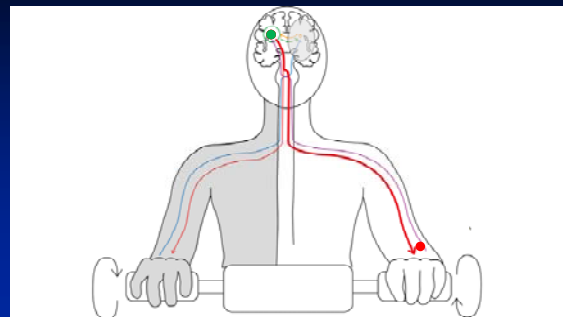


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Stroke: cooperative hand movements

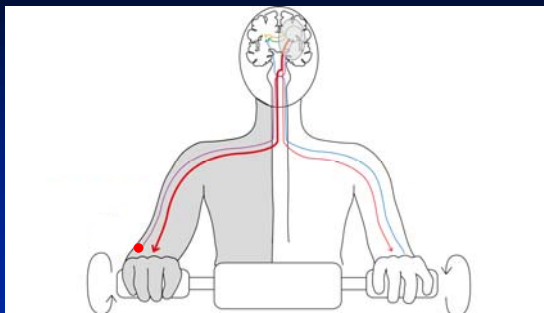


Cooperative hand movements



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Cooperative hand movements



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Consequence for hand rehabilitation

- Functional training should be supplemented by cooperative movements required in daily life activities.

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Conclusions I

1. Therapy should be directed to take advantage of the plasticity of the CNS by a functional training.
2. Functional training:
 - provision of appropriate proprioceptive input
 - task-specific activation of neural links
3. Close interaction between unaffected and affected side in stroke subjects: impaired control of afferent input during locomotion and cooperative hand movements

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Conclusions II

4. Clinical symptoms and signs do not correlate with movement disorder.
5. Secondary (compensatory) changes within muscles and connective tissue (i.e. loss of sarcomeres; subclinical muscle contracture) contribute to spastic movement disorder.
6. The aim of treatment/rehabilitation should be directed to improve movement disorder (and not to clinical signs).

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Coworkers:
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