Interventions in restoring function in spinal injury with chronic paralysis

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How can we restore movement?

- Sensors in muscles and joints
- Activate muscles and generates movement
- Compares expected movement with real movement
- Think about performing a movement

Activate muscles and generates movement

Think about performing a movement

How can we restore movement?
Traditional rehabilitation approaches
Physical therapy

Exoskeletons

Functional electrical stimulation

### Channel Settings

<table>
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<tr>
<th>Channel</th>
<th>Start pulse</th>
<th>Stop pulse</th>
<th>Max. current (mA)</th>
<th>POS Pulsedwidth (uS)</th>
<th>Interpulsedwidth (uS)</th>
<th>NEG Pulsedwidth (uS)</th>
<th>1+Pulse first</th>
<th>OnNeg. pulse first</th>
<th>Ramp up time (ms)</th>
<th>Ramp down time (ms)</th>
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</table>

**Cycle settings:**
- Number of pulses of the crank sensor: 360
- Minimum crank revolutions per minute: 1

**Stimulation settings:**
- Stim. Frequency (Hz): 50
- Number of steps to max current: 10
- Maximum Voltage limit (V): 160

**Manual current change settings:**
- Increment step (mA): 5
- Set absolute max. current

**Program:**
- Delete program
- Upload settings to program
- Get stimulator parameters
- Save parameters to file
- Load parameters from file

**Berkel Bike**

**Crank turns per minute**

**Angle:**
- 225
- 315

**Puls Nr:**
- 15

**Help:**
New rehabilitation approaches
Electrical stimulation of the spinal cord

Improved from 23 to 24 and the sum of the sensory scores from 83 to 86 (Table 1, and Fig. S1 in the Supplementary Appendix).

Participant 1 had a spontaneous hip fracture (he was stepping on the treadmill with body-weight support) after 1 week of training, without a fall, and resumed training 1 year later. He had a total of 176 sessions over a period of 62 weeks,

Thought-controlled rehabilitation

BioSpine: safe and simple to use

Measured data

Real world

Digital twin

Control devices

Automatic

Measured data

BioSpine: safe and simple to use

Real world

Digital twin

Control devices

Automatic
BioSpine: first prototype

Measured data

Digital twin

Control devices

Automatic

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Menzies Health Institute Queensland

MAiC

Queensland, Australia
BioSpine: improving thought-control