A new device using EMG signals for upper limb treatment in patients with stroke: a proof of concept study

Background

Only 5% to 20% of hemiplegic stroke patients demonstrate complete functional recovery of the paretic arm. Therapy should comprise intensive repetitive movements in which the patient is actively involved. In this context, robotic devices offer a unique training approach that may enhance motor outcomes beyond what is possible with conventional motor therapy.

Methods

This proof of concept study describes the design and preliminary application of a new device for upper limb treatment in patients with stroke. Electromyographic (EMG) signals of the biceps and triceps muscle serve as the input signals for the actuator. When the intended EMG signal of the biceps or triceps muscle exceeds a pre-set level of activity, the respective flexion or extension movement of the elbow joint is assisted by the device and active participation of the user is ensured. Preliminary application was performed in two subjects with chronic upper limb hemiparesis to consider feasibility of the system and validity of the device to motor functioning of the upper limb.

Results

None of the subjects experienced adverse events during or after 30 minutes training with the device. The active range of motion of the elbow joint increased in both subject after therapy. One of the two subjects demonstrated decreased spasticity of the elbow flexors measured with the Modified Ashworth Scale and one subject showed a 2 point improvement on the Fugl-Meyer upper limb assessment. The device was perceived as highly useful for improving the motor functioning of the affected upper limb by both subjects.

Conclusion

The device developed in this study has proven to be save and feasible for the training of elbow movements of the hemiparetic upper limb in patients with chronic stroke and is perceived as highly useful by the users. First results are promising but extensive research including more subjects and more frequent therapy with the device is needed to confirm clinical validity.