

Music-supported training of motor functions after stroke

Summary

Motor impairment represents one of the major sequelae of stroke. Scientifically founded and efficacious therapies of these impairments are scarce. Based on the finding that piano training in novices leads to profound changes in neural activations over three weeks, a training program using musical instruments as training devices was developed.

This program was evaluated in 32 stroke patients with moderately impaired motor function and no previous musical experience. Patients participated in an intensive step-by-step training, that began with the paretic extremity, and was followed by training of both extremities. The training was applied in 15 sessions over a periode of three weeks in addition to conventional treatment. Fine as well as gross motor skills were trained by using either a MIDI-piano or electronic drum pads; both instruments emitted musical tones. Thirty stroke patients undergoing exclusively conventional therapies were recruited as a control group. Fifteen additional patients were given conventional therapy supplemented by a training of motor functions according to Constraint-induced Movement Therapy (Taub et al., 1993); training comprised 15 sessions of 30 min duration over three weeks. Behavioral pre- and post-treatment motor functions were monitored using a computerized movement analysis system and an established set of motor tests (e.g. Box and Block Test). To investigate the activity of cortical regions in the control of movement, we studied event-related desynchronization/synchronization and event-related coherences from all 77 patients performing self-paced movements of the right index finger (MIDI-piano) and of the whole arm (drum pads).

Patients showed significant improvement after music-supported training in fine as well as gross motor skills with respect to speed, precision and smoothness of movements as shown by 3D movement analysis and motor tests compared to the control group without any additional treatment and, in comparison to the other control group with additional training of motor functions (Taub) in all fine motor dexterities. Furthermore, compared to the control patients, motor control in everyday activities improved significantly. Neurophysiological data showed a significantly larger decrease of EEG signal (power) before movement onset in the music-supported training group in the post training register, which is associated with increased corticospinal excitability, whereas almost no pre-post-training changes were observed in both control groups. The music-supported training group presented a pronounced enhancement of the coherences after training compared to the control groups, especially in the drum condition.

Taken together, the present work shows that the therapeutic strategy developed here is an effective approach for motor skill rehabilitation of stroke patients.