Three-dimensional, task-specific robot therapy of the arm after stroke: a multicentre, parallel-group randomised trial


ABSTRACT

Objective: To assess whether robotic training of an affected arm with ARMin – an exoskeleton robot that allows task-specific training in three dimensions – reduces motor impairment more effectively than conventional therapy.

Design: Multicenter, parallel-group randomised trial.

Setting: Patients were trained in four clinical centers in Switzerland: Uniklinik Balgrist, Reha Rheinfelden, Zentrum für Ambulante Rehabilitation Zürich, Zürcher Höhenklinik Wald.

Participants: Seventy-seven chronic patients aged ≥18 years more than 6 months after a cerebrovascular accident with moderate to severe arm paresis, as indicated by a score of 8 to 38 on arm section of Fugl-Meyer assessment (which has a maximum of 66 points).

Intervention: Randomly assigned (1:1) the patients received either robotic (with ARMin) or conventional therapy for at least 45min three times per week for 8 weeks (total of 24 sessions).

Main Outcome Measures: Primary outcome measure was the Fugl-Meyer assessment of upper extremity (FMA-UE). Secondary outcome measures included the Wolf Motor Function Test, quality of movement section of the Motor Activity Log, the Stroke Impact Scale, the Goal Attainment Scale, the modified Ashworth Scale. Furthermore, the mean strength was measured by ARMin and the grip strength with a handheld dynamometer. Measures were done 3 to 4 weeks before assignment, immediately before therapy, after 4 weeks of therapy, at the end of therapy (week 8) and 16 and 34 weeks after start of therapy.

Results: Changes in FMA-UE scores were significantly higher in patients assigned to robotic therapy than in those assigned to conventional therapy. The biggest difference was found comparing the most severely affected patients in both groups: these patients profited most from robotic therapy. About a third of the patients assigned to robotic therapy achieved FMA-UE gains of at least 5 points (= threshold for the minimum clinically important difference), compared with only a quarter of patients assigned to conventional therapy. Gains in mean muscle strength were significantly higher in patients assigned to conventional therapy than in those assigned to robotic therapy. Despite the fact that the robot assisted group had gained higher values at the FMA-UE faster, at week 34 both groups reached a similar value. No significant differences were recorded between the two treatment groups for any of the secondary outcomes. The study interventions caused no serious side-effects.

Conclusions: Task-oriented robotic training with the ARMin is safe and reduces motor impairment of the arm and hand more effectively than does conventional therapy after stroke, particularly in chronic patients with moderate to severe impairment. Patients assigned to robotic therapy gained motor function faster than did those assigned to conventional therapy. The higher intensity of training with the ARMin might be an important factor contributing to the difference, especially in patients with severe impairments.

Paper Reference: