Upper limb robot-assisted training after severe paresis in subacute stroke: An innovative paradigm to track motor performance

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Keywords: Hemiparesis; Upper limb; Sub acute stroke; Robot-assisted training
Objective: The present study investigated patient/robot interactions within an upper limb robot-assisted training in subacute stroke patients.
Methods: Nineteen subacute stroke survivors (8 females; age 53 ± 17 [19–83] years; time from stroke, 49 ± 19 days) with severe upper limb paresis (mean Fugl–Meyer Assessment score, 17 ± 6/66 or mean Motricity Index 41 ± 2/100) carried out 16 sessions (3/week, 35 days) of robot-assisted shoulder/elbow training (InMotion 2.0, IMT, Inc., MA, USA) combined with standard therapy. The values of three parameters (Guidance, Robot Power and time allotted to close the slot) were analysed and compared after the 80th movement performed at S1, S4, S8, S12 and S16 (ANOVA, post-hoc Tukey).
Results: The time allotted to close the slot decreased at S4 (P = 0.038) when we observed a decrease in guidance only at S16 (P = 0.026). The Robot Power remained unchanged until S16.
Discussion: This study demonstrated that some robotic device enables the quantification of both patient’s participation and motor recovery strategies. The results showed that recovery process followed the classical speed/accuracy trade-off, with an improvement of speed before accuracy at a constant force supplied by the robot.

Further reading
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Robot-assisted rehabilitation of the paretic upper limb after stroke: The ARAMIS robot

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Keywords: Stroke; Rehabilitation; Robotic; Upper Limb.
Background: ARAMIS is an innovative dual-exoskeleton for the rehabilitation of the paretic upper limb after stroke. ARAMIS allows three main strategies:
– asynchronous exercise;
– synchronous exercise;
– virtual exercise.
Methods: Twenty subacute hemiplegic inpatients with ischemic or hemorrhagic stroke were treated daily in 60-min rehabilitation sessions and over periods not exceeding 8 weeks.
Results: The Fugl–Meyer (modified by Lindmark and Hamrin) total score improved from 48 ± 18 at baseline to 75 ± 27 at the end of the ARAMIS rehabilitation protocol (P < 0.0003), with a mean improvement of 56%. The score for pain improved from 4.5 ± 2 to 7 ± 1.2 (P < 0.0004) and the overall motor function improved from 11.7 ± 10 to 27.5 ± 17.4 (P < 0.004). The FIM total score improved from 65 ± 21 to 94 ± 14 (P < 0.001).
Discussion: The results support the suggested potentialities of robot-mediated rehabilitation treatments of these patients and the hypothesis that improvement in motor abilities after brain injury follows the proximal-to-distal progression.

Further reading

Robot-assisted rehabilitation therapy combined with transcranial direct current neuromodulation for the recovery of the upper limb in the subacute phase of stroke

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Keywords: tDCS; Robotic rehabilitation; Upper Limb; Stroke
Objectives: Evaluate the efficacy of the combined use of robot for the upper limb recovery and transcranial direct current neurostimulation (tDCS) therapy for the rehabilitation of patients in subacute phase of stroke.
Methods: We select patients without epilepsy nor head injury, with a stroke occurred in the previous two months. All patients perform standard daily motor rehabilitation plus 45’ of robot therapy with MIT-Manus for a total period of three weeks (5 times/week); at the same time is randomly applied tDCS with an anodal (case group) or SHAM (controls) stimulation on the injured hemisphere with 1.5 mA for 30’. The clinical parameters assessed are: Ashworth modified scale, Fugl–Meyer for upper limb, Motor Power Score, Motricity Index, Frenchay Arm test, Box and Blocks. Robotic parameters considered are: voluntary activity index, efficacy–speed–smooth and precision index of movements.
Results: We actually selected 6 patients: four have been stimulated with sham and 2 with anodal tDCS. Both clinical and robotic parameters improved in all patients, apparently better in the case group versus controls.
Discussion: We are currently in the selection phase and we need a sufficient sample dimension to correctly assess efficacy of combined therapy.

Age effect on upper limb kinematics assessed by REAplan robot. A prospective study in healthy children from 3 to 12 years old

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Keywords: Robotics; Outcome assessment; Biomechanics; Kinematics; Children; Upper extremity.
Background: Kinematics assessment is recommended to evaluate upper limb movements quantitatively. The aims of this study were to develop norms of upper limb kinematics for healthy children and to determine the effect of age on kinematics indices.
Methods: Ninety-three healthy children (3 to 12 years) participated in the study. Five kinematics indices were computed from two unidirectional (i.e., reaching a target and performing a back-and-forth movement) and two geometrical (i.e., drawing a circle and a square) tasks [1]. Each task was performed 10 consecutive times with the REAPlan, which is a distal effector robotic device that allows upper limb displacements in the horizontal plane.
Results: Four indices showed an improvement from 3 to 6 years (P < 0.05). Indeed, the straightness and smoothness results were more variable during the 10 cycles of movements and the amplitude of movements was lower in the youngest children than in older children. After 6 years, all indices remained stable.