

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Abdullah et al., 2011 PEDro score: 6/10	20 patients with acute and subacute stroke	UE robot-assisted training (n=9) vs. Conventional rehabilitation (n=11). <u>Treatment program:</u> 45 minutes/session, 3 times/week for 8-11 weeks. UE robot-assisted training consisted of vertical and horizontal trajectory exercises and object manipulation using passive, active assisted and active movements. Conventional rehabilitation consisted of task-specific training, passive, active and resistive exercises.	<b>At post-treatment (8-11 weeks):</b> (-) Chedoke Arm and Hand Activity Inventory (+) Chedoke McMaster Stroke Assessment of Arm and Hand - arm score (+) Chedoke McMaster Stroke Assessment of Arm and Hand - hand score (-) Chedoke McMaster Stroke Assessment of Arm and Hand - pain inventory score (-) Patient satisfaction
Aisen et al., 1997 PEDro score: N/A (quasi-experimental study)	20 patients with acute stroke	UE robot-assisted training (n=10) vs. Sham robot-assisted therapy (n=10) <u>Treatment program:</u> UE robot-assisted training consisted of goal-directed elbow and shoulder movements using the <b>MIT-Manus</b> robotic device. The intervention was provided for 4-5 hours per week during acute rehabilitation (9 weeks duration). Sham robot-assisted therapy consisted of weekly or biweekly exposure to the device with active movement of the robotic arm.	<b>At discharge (9 weeks):</b> (-) Fugl-Meyer Assessment of Upper Extremity (-) Motor Status Scale – proximal score (-) Motor Status Scale – distal score (-) Motor Power Score (-) Functional Independence Measure
Amirabdollahian et al., 2007 PEDro score: N/A (single-case series with randomized multiple baseline)	31 patients with chronic stroke	Robot-assisted UE training vs. Sling suspension UE training vs. No intervention using an ABC/ACB intervention design	<b>At the end of each phase (A, B, C):</b> (+) Fugl-Meyer Assessment of Upper Extremity* (-) Motor Assessment Scale (-) Active/passive ROM – shoulder (-) Active/passive ROM – elbow * favoring robot-assisted UE training and sling-

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		<p><u>Treatment program:</u> Robot-assisted UE training consisted of reaching and withdrawal movements within a virtual environment using the <b>GENTLE/S</b> system in 3 modes: patient passive, active-assisted, and active. Sling suspension UE training comprised shoulder and elbow flexion/extension exercises. ABC and ACB designs consisted of 3 phases: (A) baseline measurement without intervention 3 times/week for 3 weeks; (B) robot-mediated training 10 minutes/session, 3 times/week for 3 weeks; (C) de-weighted sling suspension training 10 minutes/session, 3 times/week for 3 weeks.</p>	suspension UE training compared to no intervention. There were no significant differences between robot-assisted UE training and sling-suspension UE training.
Bovolenta et al., 2009 PEDro score : N/A (quasi-experimental study)	14 patients with subacute or chronic stroke	<p>UE robot-assisted training <u>Treatment program:</u> 20 45-minute sessions, 5 days/week for 4 weeks. Treatment was provided using the <b>ReoGo<sup>tm</sup></b> (Motorics Medical Ltd, Israel) device for a total of and included shoulder and elbow passive and active movements in 3 dimensions and on all spatial planes while reaching the target on the computer screen.</p>	<p><b>At post-treatment (4 weeks):</b> (+) Modified Fugl-Meyer Assessment of the Upper Extremity (-) Ashworth Scale - shoulder (+) Ashworth Scale – elbow (-) Ashworth Scale – wrist (-) Pain (Visual Analogue Scale, VAS) (+) Frenchay Arm Test (+) Box and Block Test (+) Functional Independence Measure – motor (-) ABILHAND (+) Medical Research Council scale - deltoid, pectoral, biceps (-) Medical Research Council scale - trapezius, internal/external rotators, triceps, wrist</p>

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			flexors/extensors, latissimus dorsi (-) Treatment satisfaction (VAS) (-) Timed Up and Go test <b>From baseline to follow-up (1 month post-treatment):</b> (+) Modified Fugl-Meyer Assessment of the Upper Extremity (-) Ashworth Scale – shoulder (+) Ashworth Scale – elbow (-) Ashworth Scale – wrist (+) Pain (VAS) (+) Frenchay Arm Test (+) Box and Block Test (+) Functional Independence Measure – motor (+) Medical Research Council scale - trapezius, deltoid, pectoralis, biceps, triceps, wrist extensors, latissimus dorsi (-) Medical Research Council scale – internal/external rotators, wrist flexors (-) Euro-Quality of Life questionnaire (+) Timed Up and Go test <b>From post-treatment (4 weeks) to follow-up (1 month post-treatment):</b> (-) Modified Fugl-Meyer Assessment of the Upper Extremity (-) Ashworth Scale – shoulder (-) Ashworth Scale – elbow (-) Ashworth Scale - wrist (+) Pain (VAS) (-) Frenchay Arm Test

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			(-) Box and Block Test (+) Functional Independence Measure – motor (-) Medical Research Council scale - trapezius, deltoid, pectoralis, biceps, triceps, wrist extensors, latissimus dorsi (-) Medical Research Council scale – internal/external rotators, wrist flexors (-) Euro-Quality of Life questionnaire (-) Timed Up and Go test
Bovolenta et al., 2011 PEDro score: N/A (quasi-experimental study)	19 patients with chronic stroke	UE robot-assisted training. <u>Treatment program:</u> 20 45-minute sessions, 5 days/week for 4 weeks. Training consisted of goal-directed, passive, active-assisted and active shoulder and elbow movements using the <b>ReoGo™</b> (Motorics Medical Ltd, Israel) device.	<b>At post-treatment (4 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (+) Frenchay Arm Test (+) Box and Block Test (+) Functional Independence Measure (FIM) motor subscale (+) Medical Research Council scale - trapezius, deltoid, pectoralis major, biceps, internal rotators, latissimus dorsi (-) Medical Research Council scale - triceps, external rotators, wrist flexors/extensors (-) Ashworth Scale – shoulder (+) Ashworth Scale – elbow (-) Ashworth Scale – wrist (-) Pain (Visual Analogue Scale, VAS) (+) Timed Up and Go Test (-) Satisfaction (VAS) <b>From baseline to follow-up (1 month post-treatment):</b> (+) Fugl-Meyer Assessment of Upper Extremity

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			(+) Frenchay Arm Test (+) Box and Block Test (+) Functional Independence Measure (FIM) motor subscale (+) Medical Research Council scale - trapezius, deltoid, pectoralis major, biceps, triceps, internal rotators, wrist flexors/extensors, latissimus dorsi (-) Medical Research Council scale - external rotators (-) Ashworth Scale – shoulder (+) Ashworth Scale – elbow (-) Ashworth Scale – wrist (+) Pain (VAS) (+) Timed Up and Go Test (-) Euro-QoL
Casadio et al., 2009 PEDro score: N/A (quasi-experimental design)	10 patients with chronic stroke	Robot-assisted upper extremity training using the <b>Braccio di Ferro device</b> . <u>Treatment program:</u> Training was provided for 10 60-75 minute sessions, once a week for 10 weeks and included goal-directed, reaching to targets movements involving the shoulder and elbow joints in a horizontal plane. Each session consisted of 63 movements and included trial with and without vision. Reaching targets where either visual (colored circles) or haptic (robot-generate force fields).	<b>At post-treatment (10 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity Function (-) Ashworth Scale (flexors muscles) (+) Performance indicators <b>At follow-up (3 months):</b> (-) Fugl-Meyer Assessment of Upper Extremity Function (-) Ashworth Scale (flexors muscles) (-) Performance indicators

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Chang et al., 2007 PEDro score: N/A (quasi-experimental study)	20 patients with chronic stroke	UE robot-assisted training <u>Treatment program:</u> 24 40-minute sessions, 3 times/week for 8 weeks Rehabilitation consisted of 30 minutes of robot-assisted, bilateral force-induced, isokinetic arm movement training ( <b>BFIAMT</b> ), followed by 10 minutes of conventional rehabilitation based on neurodevelopmental principles.	<b>At post-treatment (8 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (-) Frenchay Arm Test (-) Modified Ashworth Scale (+) Grip strength (+) Arm push and pull strength (+) Peak velocity (+) Percentage of time to peak velocity (+) Movement time (+) Normalized jerk score <b>At follow-up (16 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (-) Frenchay Arm Test (-) Modified Ashworth Scale (+) Grip strength (+) Arm push and pull strength (-) Peak velocity (-) Percentage of time to peak velocity (-) Movement time (-) Normalized jerk score
Colombo et al., 2010 PEDro score : N/A (quasi-experimental study)	18 patients with chronic stroke	UE robot-assisted training <u>Treatment program:</u> 2 sessions/day, 5 days/week for 3 weeks Sessions comprised 4 5-minute cycles of exercises interspersed by 3-min rest and included goal-directed active and active-assistive reaching movements in the horizontal plane using the elbow-shoulder manipulator mechatronic system ( <b>MEMOS</b> ).	<b>At post-treatment (3 weeks):</b> (+) Motor Status Score (+) Fugl-Meyer Upper Extremity Assessment (+) Movement dynamics (normalized force control parameter and force directional error) (+) Co-contraction indices of biceps brachii/triceps brachii, anterior/posterior deltoid, and pectoralis major/teres major

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			muscle groups* *statistical significance not reported.
Coote et al., 2008 PEDro : N/A (single-case series with multiple baseline)	20 patients with subacute and chronic stroke	Robot-assisted UE training Vs. Sling suspension UE training Vs. No intervention using an ABC/ACB intervention design <u>Treatment program:</u> Robot-assisted UE training consisted of reaching and withdrawal movements within a virtual environment using the <b>GENTLE/S</b> system in passive, active assisted and active modes. Sling suspension UE training comprised shoulder and elbow flexion/extension exercises. ABC and ACB designs consisted of 3 phases: (A) baseline measurement phase without intervention 3 times/week for 3 weeks (B) robot-mediated training for 10 minutes 3 times/week for 3 weeks (C) sling suspension training for 10 minutes 3 times/week for 3 weeks.	<b>At the end of each phase (A, B, C):</b> (-) Fugl-Meyer Assessment of Upper Extremity (+) Motor Assessment Scale* (-) Shoulder flexion active range of motion (ROM) (-) Modified Ashworth Scale (-) Pain (VAS) (-) Nottingham Sensory Assessment (-) Star Cancellation Test * favoring robot-mediated therapy compared to sling suspension exercises in Group 2 only (ACB).
Connelly et al., 2010 PEDro score: 6/10	16 patients with chronic stroke	UE robot-assisted training with virtual reality and task-oriented training (n=8) vs. Virtual reality and task-oriented training alone (n=8)  <u>Treatment program:</u>	<b>At post-treatment (6 weeks) and follow-up (10 weeks):</b> (-) Box and Block Test (-) Fugl-Meyer Assessment of the Upper Extremity (-) Fugl-Meyer Assessment of the Upper

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		30 minutes virtual-reality grasp/release exercises + 30 minutes task-oriented training using real objects, 3 times/week for 6 weeks Robot-assisted training comprised use of the <b>PneuGlove</b> during virtual reality and task-oriented exercises.	Extremity - hand/wrist score (-) Grip strength (-) Lateral pinch (-) Palmar pinch
Conroy et al., 2011 PEDro score: 6/10	62 patients with chronic stroke	Robot-assisted planar reaching (n=20) vs. Combined planar and vertical robot-assisted reaching (n=21) vs. Intensive conventional arm exercises (n=21) <u>Treatment program:</u> 18 1-hour sessions, 3 times a week for 6 weeks using the <b>MIT-Manus (InMotion 2 and InMotion Linear robots)</b> devices.	<b>At post-treatment (6 weeks):</b> (-) Fugl-Meyer Assessment of Upper Extremity (-) Wolf Motor Function Test (+) Stroke Impact Scale - Activities of Daily Living (ADLs) score* (-) Stroke Impact Scale - Hand score (-) Stroke Impact Scale - Mobility score <i>Robot metrics</i> (+) Aim** (-) Deviation (-) Mean speed (-) Peak speed (-) Smoothness (-) Duration (-) Ellipse ration (-) Z force <b>At follow-up (12 weeks):</b> (-) Fugl-Meyer Assessment of Upper Extremity (-) Wolf Motor Function Test (-) Stroke Impact Scale - ADLs score (-) Stroke Impact Scale - Hand score (-) Stroke Impact Scale - Mobility score <i>Robot metrics:</i> (+) Aim**



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			(-) Deviation (-) Mean speed (-) Peak speed (-) Smoothness (-) Duration (-) Ellipse ration (-) Z force * In favour of planar with vertical robotic reach training compared with intensive conventional rehabilitation. A significant between-group difference was also reported in a subgroup of patients with severe impairment (baseline FMA score $\leq 25$ ), favoring planar with vertical robotic reach training compared with intensive conventional rehabilitation. ** Favoring both robotic reach training groups compared with intensive conventional rehabilitation.
Dipietro et al., 2012 PEDro score : N/A (quasi-experimental study)	158 patients with acute and chronic stroke	UE robot-assisted training. <u>Treatment program:</u> 18 1-hour sessions Training consisted of 1024 point-to-point reaching (elbow and shoulder) movements in passive, active-assistive and active modes using the <b>MIT-Manus (InMotion2)</b> robotic device.	<b>At post-treatment:</b> <u>Patients with acute stroke</u> (-) Fugl-Meyer Assessment of Upper Extremity <u>Trained point-to-point task:</u> (+) Speed shape (+) Number of peaks (+) Jerk metric (+) Mean speed (+) Peak speed (+) Duration (+) Number*

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			(+) Peak* (-) Duration* (+) Overlap* (+) Interpeak distance* (-) Skewness* (+) Kurtosis* <i>Untrained circle drawing task:</i> (+) Speed shape (+) Number of peaks (-) Jerk metric (+) Mean speed (+) Peak speed (+) Duration (-) Number* (+) Peak* (+) Duration* (+) Overlap* (-) Interpeak distance* (-) Skewness* (+) Kurtosis* <u>Patients with chronic stroke</u> (-) Fugl-Meyer Assessment of Upper Extremity <i>Trained point-to-point task:</i> (+) Speed shape (+) Number of peaks (+) Jerk metric (+) Mean speed (-) Peak speed (+) Duration (+) Number*

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(+) Peak* (+) Duration* (+) Overlap* (-) Interpeak distance* (-) Skewness* (+) Kurtosis* <i>Untrained circle drawing task</i> (+) Speed shape (+) Number of peaks (-) Jerk metric (-) Mean speed (-) Peak speed (-) Duration (+) Number* (+) Peak* (+) Duration* (+) Overlap* (+) Interpeak distance* (-) Skewness* (+) Kurtosis* * sub movement analyses
Dovat et al., 2010 PEDro score : N/A (case study)	2 patients with chronic stroke	UE robot-assisted training <u>Treatment program:</u> 16 1-hour sessions over 8 weeks Training consisted of robot-assisted, goal-directed, finger coordination (opening and closing the hand against an elastic load) and finger independence (specific finger active movement) exercises using the Hand Cable-Actuated Rehabilitation ( <b>HandCARE</b> ) system.	<b>At post-treatment (8 weeks):</b> (-) Chedoke McMaster Impairment Inventory (+) Finger movement smoothness (hand opening only) and coordination (hand opening and closing) (+) Force modulation (middle finger only) and finger independence

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Fasoli et al., 2004 PEDro score : 6/10 (Retrospective analysis of Volpe et al., 2000 study)	56 patients with acute stroke	<p>UE robot-assisted training (n=30) vs. Limited exposure to robotic device (n=26)</p> <p><u>Treatment program:</u> Robotic training consisted of robot-assisted goal-directed shoulder and elbow movements with auditory feedback using the <b>MIT-Manus</b> device during 1-hour sessions, 5 days/week over 6-7 weeks. Control intervention consisted of 50% of robot-assisted UE training trials performed with the unaffected hand for 1 hour per week over 5 weeks.</p>	<p><b>From interim to discharge:</b> (+) Fugl-Meyer Assessment of Upper Extremity (+) Motor Status Scale - shoulder/elbow score (-) Motor Status Scale - wrist/hand score (+) Motor Power Score NOTE: scores were taken at interim and discharge for the purpose of comparing the effect of longer rehabilitation.</p>
Fazekas et al., 2007 PEDro score: 2/10	30 patients with chronic hemiparesis resulting from stroke (n=22) or traumatic brain injury (n=8)	<p>UE robot-assisted physiotherapy and Bobath therapy (n=15) vs. Bobath therapy alone (n=15)</p> <p><u>Treatment program:</u> All participants received 30-minute session of Bobath therapy on 20 consecutive work days. The intervention group received an additional 30 minutes/session of robot-mediated physiotherapy using the <b>REHAROB Therapeutic System</b> that provides passive shoulder and elbow exercises.</p>	<p><b>At post-treatment (4 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow score* (+) Rivermead Motor Assessment – arm score* (+) Functional Independence Measure (FIM) - self care score* (+) Modified Ashworth Scale - shoulder adductors (+) Modified Ashworth Scale - elbow flexors (-) ROM - shoulder (+) ROM - elbow* Note: between-group analyses were not performed; results indicate significant improvements following robot-assisted physiotherapy. * significant improvement also seen in control group.</p>

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Fischer et al., 2007 PEDro score: 4/10	15 patients with chronic stroke	Cable orthosis for self-assisted digit extension (n=5) vs. Pneumatic orthosis for automated-assisted digit extension (n=5) vs. No orthosis (no assistance, n=5) <u>Treatment program:</u> 18 1-hour sessions, 3 times/week for 6 weeks; during sessions participants performed 30 functional grasp-and-release tasks involving virtual and actual objects.	<b>At post-treatment (6 weeks) and follow-up (10 weeks):</b> (-) Wolf Motor Function Test – Time score (-) Box and Block Test (-) Fugl-Meyer Assessment of Upper Extremity (-) Rancho Los Amigos Functional Test of the Hemiparetic Upper Extremity (-) Grip strength (dynamometer) (-) MCP active extension range of motion (-) MCP peak extension velocity (-) MCP spasticity (-) MCP isometric strength on flexion/extension
Frisoli et al., 2009 PEDro score: N/A (quasi-experimental study)	9 patients with chronic stroke	UE robot-assisted training <u>Treatment program:</u> Training was provided for 18 1-hour sessions, 3 times/week for 6 weeks and included goal-directed reaching, path following and free motion tasks using the <b>Light Exoskeleton (L-EXOS)</b> device (i.e. five DOF force-feedback exoskeleton for the paretic arm with integrated virtual reality system).	<b>At post-treatment (6 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (-) Modified Ashworth Scale (-) Passive ROM – shoulder and elbow (+) Active ROM – shoulder and elbow
Hesse et al., 2003 PEDro score: N/A (quasi-experimental study)	12 patients with chronic stroke	Robot-assisted upper extremity training using a portable, 1 DOF trainer device <u>Treatment program:</u> Bilateral passive and active practice of 2 movements: elbow pronation and supination and wrist dorsiflexion and volarflexion.	<b>At post-treatment (3 weeks):</b> (+) Modified Ashworth Scale - wrist and finger (-) Modified Ashworth Scale – elbow (-) Rivermead Motor Assessment (-) Patients' satisfaction <b>At follow-up (3 months):</b> (-) Modified Ashworth Scale - elbow, wrist and finger

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		Patients received 15 15-minute sessions, once per day for 3 weeks in addition to conventional physical and occupational therapy.	(-) Rivermead Motor Assessment (-) Patients' satisfaction
Housman et al., 2009 PEDro score: 5/10	34 patients with chronic stroke	UE robot-assisted training (n=17) vs. Conventional exercise group (n=17) <u>Treatment program:</u> 24 1-hour sessions, 3 times/week for 8 to 9 weeks) of UE training using computer games in a gravity-supported environment using a passive instrumented arm orthosis (T-WREX).	<b>At post-treatment (8-9 weeks):</b> (-) Fugl-Meyer Assessment of Upper Extremity (-) Rancho Functional Test of the Hemiparetic Upper Extremity (-) Motor Activity Log – Amount of Use (-) Motor Activity Log – Quality of Movement (-) Free reaching (-) Reaching ROM (-) Grip strength (-) Patient satisfaction <b>At follow-up (6 months):</b> (+) Fugl-Meyer Assessment of Upper Extremity (-) Rancho Functional Test of the Hemiparetic Upper Extremity (-) Motor Activity Log – Amount of Use (-) Motor Activity Log – Quality of Movement (-) Free reaching (-) Reaching ROM (-) Grip strength (-) Patient satisfaction
Hu et al., 2007 PEDro score: N/A (quasi-experimental study)	7 patients with chronic stroke	Robot-assisted elbow training <u>Treatment program:</u> 20 1.5 hour sessions, 3-5 times/week for 7 weeks. Training included elbow flexion/extension goal-directed movements in a horizontal plane.	<b>At post-treatment (7 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (+) Motor Status Scale (+) Modified Ashworth Scale – elbow

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Hu et al., 2009 PEDro score: N/A (quasi-experimental study)	15 patients with chronic stroke	Robot-assisted wrist training. <u>Treatment program</u> 20 sessions, 3-5 times/week for 7 weeks. Training comprised wrist flexion/extension goal-directed movements in a horizontal plane using an EMG-driven motor system.	<b>At post-treatment (7 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow (+) Fugl-Meyer Assessment of Upper Extremity - wrist/hand (-) Action Research Arm Test (+) Modified Ashworth Scale – elbow (+) Modified Ashworth Scale – wrist (-) Functional Independence Measure (FIM)
Hwang et al., 2012 PEDro score: 6/10	17 patients with subacute to chronic stroke	Full-time robot-assisted individual finger rehabilitation (n=9) vs. Early passive range of motion therapy and part-time robot-assisted individual finger rehabilitation (n=8) <u>Treatment program</u> 20 45-minute sessions, 5 days/week for 4 weeks or 2 weeks respectively. Robot-assisted individual finger rehabilitation consisted of goal-directed, passive, active-assisted and active grasp and release training using a robot that allows for individual finger synchronization for 20 minutes, and grasp/release training using virtual reality for 20 minutes/session. Passive therapy consisted of 2 weeks passive range of motion training prior to 2 weeks of robot-assisted intervention.	<b>At mid-treatment (2 weeks), post-treatment (4 weeks) and follow-up (8 weeks):</b> (+) Jebsen Taylor Hand Function Test (-) Stroke Impact Scale - hand score (+) Fugl-Meyer Assessment of Upper Extremity Function - wrist/hand score (-) Fugl-Meyer Assessment of Upper Extremity Function - shoulder/elbow score (-) Ashworth Scale – wrist (-) Ashworth Scale – elbow (-) Nine Hole Peg Test (+) Grasp strength (+) Pinch strength (+) Active ROM of the second metacarpalphalangeal joint.
Kahn et al., 2006 PEDro score: 4/10	19 patients with chronic stroke	Robot-guided active-assisted reaching exercises (n=10) vs.	<b>At post-treatment (8 weeks):</b> (-) Chedoke McMaster Test

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		<p>Task-matched unassisted reaching exercises (n=9).  <u>Treatment program:</u>            24 45-minute intervention sessions over 8 weeks.            Sessions consisted of 10 reaches to 5 targets at different locations across an individual's supported passive range of motion.            Robot-assisted training consisted of active-assistive reaching movements using the <b>ARM Guide</b>.            Unassisted free reaching training consisted of matched number of reaches to the same targets as those in the robot-assisted group without using the device or any other limb support.</p>	<p>(-) Rancho Los Amigos Functional Test of the Hemiparetic Upper extremity            (-) Limb stiffness            (-) Active supported reach range            (-) Reach velocity            (+) Free reach smoothness            (-) Free reach straightness            (-) Free reach unsupported range</p>
Kahn et al., 2001 PEDro score: 6/10	10 patients with chronic stroke	<p>Robot-assisted upper extremity training (n=6) vs.            Non-robotic free-reaching training (n=4).  <u>Treatment program:</u>            All patients received 24 sessions over 8 weeks.            Robot-assisted upper extremity training was performed using the <b>ARM Guide</b> in assistive goal-directed forward reaching movements to a set of 7 targets.            Free-reaching training comprised the same reaching exercises while unattached to the ARM Guide.</p>	<p><b>At post-treatment (8 weeks):</b>            (-) Chedoke-McMaster Scale            (-) Rancho Los Amigos Functional Test for the Hemiparetic Upper Extremity            (-) UE active ROM            (-) Peak velocity during reaching            (-) Passive resistance to reaching movement</p>
Lambercy et al., 2011 PEDro score: N/A (quasi-experimental study)	15 patients with chronic stroke	<p>UE robot-assisted training  <u>Treatment program:</u>            18 1-hour sessions over 6 weeks.            Training consisted of goal-directed hand opening/closing and forearm pronation/supination exercises using the <b>HapticKnob</b> device.</p>	<p><b>At post-treatment (6 weeks):</b>            (+) Fugl-Meyer Assessment of Upper Extremity - total score            (-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score            (+) Fugl-Meyer Assessment of the Upper</p>



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			Extremity - wrist/hand score (+) Motricity Index - total score (+) Motricity Index - shoulder/elbow score (-) Motricity Index - hand/fingers score(-) Functional Test of the Hemiparetic Upper Extremity (+) Motor Assessment Scale (-) Modified Ashworth Scale (-) Nine Hole Peg Test (-) Grip strength (-) Pain (VAS) (-) Patients satisfaction (+) Hand motor control (+) Motion smoothness (+) Time <b>At follow-up (12 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity - total score (-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (+) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (+) Motricity Index - total score (+) Motricity Index - shoulder/elbow score (-) Motricity Index - hand/fingers score (-) Functional Test of the Hemiparetic Upper Extremity (+) Motor Assessment Scale (+) Modified Ashworth Scale (-) Nine Hole Peg Test

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			(-) Grip strength (-) Pain – (VAS) (-) Patients satisfaction
Liao et al., 2011 PEDro score: 7/10	20 patients with chronic stroke	Robot-assisted UE rehabilitation (n=10) vs. Dose-matched conventional rehabilitation (n=10) <u>Treatment program:</u> 90-150 minutes /day, 5 days/week for 4 weeks. Robot-assisted UE rehabilitation was performed using the <b>Bi-Manu-Track</b> robotic arm trainer that enabled bilateral mirror-like movement cycles consisting of forearm pronation/supination and wrist flexion/extension in 4 modes: passive-passive, passive-active, active-active, and active-passive. Dose-matched conventional rehabilitation comprised occupational therapy techniques with an emphasis on functional task training: arm exercises or gross motor, muscle strengthening, fine motor or dexterity, and ADL or functional task training.	<b>At post-treatment (4 weeks):</b> (+) Arm activity ratio (+) Fugl-Meyer Assessment of the Upper Extremity (-) Functional Independence Measure (+) Motor Activity Log - Amount of Use (+) Motor Activity Log - Quality of Movement (+) ABILHAND
Lo et al., 2010 PEDro score: 7/10	127 patients with chronic stroke	Intensive robot-assisted therapy (n=49) vs. Intensive conventional rehabilitation (n=50) vs. Usual care (n=28) <u>Treatment program:</u> Intensive robot-assisted therapy was provided using the <b>MIT-Manus</b> device for 36 1-hours sessions over a period of 12 weeks and consisted of 4 modules: a shoulder-	<b>At post-treatment (12 weeks):</b> (-) Fugl-Meyer Assessment of the Upper Extremity (-) Wolf Motor Function Test (-) Modified Ashworth Scale (+) Stroke Impact Scale* -) Pain (VAS) <b>Over 36 weeks:</b> (+) Fugl-Meyer Assessment of the Upper

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		<p>elbow unit for horizontal movements, an antigravity unit for vertical movements, a wrist unit for flexion/extension, abduction/adduction and pronation/supination; and a grasp hand unit for closing and opening movements. Intensive conventional rehabilitation consisted of a structured protocol using conventional rehabilitative techniques: assisted stretching, shoulder-stabilization activities, arm exercises, and functional reaching tasks; and matched robot-assisted therapy in schedule and in the form and intensity of movement.</p>	<p>Extremity*            (+) Wolf Motor Function Test*            (-) Modified Ashworth Scale            (+) Stroke Impact Scale*            (-) Pain (VAS)            Note:*favoring robot-assisted therapy compared to usual care</p>
Luft et al., 2004 PEDro score: 6/10	21 patients with chronic stroke	<p>Bilateral arm training with rhythmic auditory cueing (n=9) vs. Standardized dose-matched therapeutic exercises (n=12).  <u>Treatment program:</u>            1 hour, 3 times/week for 6 weeks.            Bilateral arm training with rhythmic auditory cueing (<b>BATRAC</b>) consisted of pushing and pulling 2 bar handles sliding in the transverse plane upon auditory cues.            Dose-matched therapeutic exercise consisted of thoracic spine and scapular mobilization, weight bearing with the paretic arm, and opening a closed fist exercises.</p>	<p><b>At 2 weeks post-intervention:</b>            (-) Fugl-Meyer Assessment of Upper Extremity*            (-) Wolf Motor Function Test – weight            (-) Wolf Motor Function Test – time            (-) University of Maryland Arm Questionnaire for Stroke            (-) Elbow strength            (-) Shoulder strength            (+) brain activation during elbow movement**            (-) Electromyography            * a significant between-group difference was seen among patients with fMRI response, in favour of BATRAC compared to standardized therapeutic exercises.            ** hemispheric activation during paretic arm movement, particularly in the contralesional cerebrum, and ipsilesional cerebellum</p>

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Lum et al., 2002 PEDro score: 6/10	30 patients with chronic stroke	UE robot-assisted training (n=15) vs. Conventional neurodevelopmental therapy (n=15). <u>Treatment program:</u> 24 1-hour sessions over 2 months. Robot-assisted UE training was performed with the mirror image movement enabler ( <b>MIME</b> ) that assists in forearm and shoulder goal-directed reaching movements in 4 modes: passive, active-assisted, active-constrained and bimanual. The control group received UE neurodevelopmental therapy and 5 minutes of exposure to the robot in each session.	<b>At mid-treatment (1 month):</b> (+) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (-) Barthel Index (-) Functional Independence Measure (FIM) <b>At post-treatment (2 months):</b> (+) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (-) Barthel Index (-) Functional Independence Measure (FIM) (+) Elbow strength (flexion, extension, abduction, adduction) (+) Shoulder strength (flexion) (+) Reach (forward-lateral and lateral at tabletop and shoulder heights; and forward-medial and forward at shoulder height) <b>At follow-up (6 months):</b> (-) Fugl-Meyer Assessment of Upper Extremity (-) Barthel Index (+) Functional Independence Measure (FIM)
Lum et al., 2006 PEDro score: 4/10	30 patients with subacute stroke	Bilateral UE robot-assisted training (n=5) vs. Unilateral UE robot-assisted training (n=9) vs.	<b>At post-treatment (4 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow score* (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		<p>Combined unilateral and bilateral UE robot-assisted training (n=10) vs. Conventional rehabilitation (n=6). <u>Treatment program:</u> 15 1-hour sessions over 4 weeks. Robot-assisted UE training was performed using the Mirror Image Movement Enabler (<b>MIME</b>) robotic device for shoulder and elbow neurorehabilitation.</p>	<p>(+) Motor Status Score (MSS) synergy score* (-) Functional Independence Measure (FIM) - self cares score (-) Functional Independence Measure (FIM) – transfers score (-) Motor Power Score (-) Modified Ashworth Scale - proximal score (-) Modified Ashworth Scale - distal score <b>At follow-up (6 months):</b> (-) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow score (+) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score** (-) Motor Status Score (MSS) synergy score (-) Functional Independence Measure (FIM) - self cares score (-) Functional Independence Measure (FIM) – transfers score (-) Motor Power Score (-) Modified Ashworth Scale - proximal score (-) Modified Ashworth Scale - distal score Note: * favoring robot-combined training compared to conventional rehabilitation. ** favoring robot-unilateral training compared to robot-combined training.</p>
MacClellan et al., 2005 PEDro score: N/A (quasi-experimental study)	30 patients with chronic stroke	<p>Robot-assisted task-specific UE training <u>Treatment program:</u> 18 1-hour sessions twice daily, 3 days/week for 4 weeks.</p>	<p><b>At post-treatment (4 weeks):</b> <i>Patients with moderate stroke impairment (FMA score &gt; 15):</i> (-) Motor Status Score - shoulder/elbow score</p>

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		<p>Training consisted of goal-directed, planar-reaching, active, active-assisted and passive tasks involving the paretic shoulder and elbow using the <b>MIT-Manus InMotion2 robot</b>.</p>	<p>(-) Motor Status Score - wrist/hand score                      (+) Wolf Motor Function Test - Functional Ability                      (-) Wolf Motor Function Test - Performance Time                      (-) Motor Power Assessment                      (-) Fugl-Meyer Assessment of the Upper Extremity - total score                      (-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score                      (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score  <i>Patients with severe stroke impairment (FMA score ≤ 15)</i>                      (-) Motor Status Score - shoulder/elbow score                      (-) Wolf Motor Function Test - Performance Time                      (-) Wolf Motor Function Test - Functional Ability                      (+) Motor Power Assessment                      (+) Fugl-Meyer Assessment of the Upper Extremity – total score                      (+) Fugl-Meyer Assessment of the Upper Extremity - elbow/shoulder score  <b>At follow-up (3 months):</b>  <i>Patients with moderate stroke impairment (FMA score &gt; 15):</i>                      (-) Motor Status Score - shoulder/elbow score                      (-) Motor Status Score - wrist/hand score                      (-) Wolf Motor Function Test - Functional Ability                      (-) Wolf Motor Function Test - Performance</p>

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			Time (-) Motor Power Assessment (-) Fugl-Meyer Assessment of the Upper Extremity - total (+) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score <i>Patients with severe stroke impairment (FMA score <math>\leq 15</math>)</i> (-) Motor Status Score (MSS) - shoulder/elbow score (-) Wolf Motor Function Test - Performance Time (-) Wolf Motor Function Test - Functional Ability (-) Motor Power Assessment (-) Fugl-Meyer Assessment of the Upper Extremity – total score (-) Fugl-Meyer Assessment of the Upper Extremity - elbow/shoulder score
Masiero et al., 2011 PEDro score: 6/10	21 patients with acute stroke	UE robot-assisted training and conventional rehabilitation (n=11) vs. Conventional rehabilitation alone (n=10). <u>Treatment program:</u> 80 minutes conventional rehabilitation + 40 minutes robot training OR additional conventional paretic arm training/day, 5 days/week for 5 weeks.	<b>At post-treatment (5 weeks) and follow-up (3 months):</b> (-) Fugl-Meyer Assessment - total score (-) Fugl-Meyer Assessment - shoulder/elbow + coordination score (-) Fugl-Meyer Assessment - wrist/hand score (-) Frenchay Arm Test (-) Box and Block Test (-) Medical Research Council – deltoid

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		<p>Robot-assisted UE training used the Neuro-Rehabilitation robot (NeReBot) to facilitate repetitive assistive proximal movements of the shoulder and elbow (flexion/extension, supination/pronation/ adduction/abduction and circular movements).</p> <p>Conventional rehabilitation included proprioceptive exercises, functional reeducation, gait training, occupational therapy and passive/active-assisted mobilization of the hand and wrist).</p>	<p>(-) Medical Research Council – biceps            (-) Medical Research Council – triceps            (-) Medical Research Council - wrist flexors*            (-) Medical Research Council - wrist extensors            (-) Functional Independence Measure motor score            (-) Modified Ashworth Scale            * significant between-group difference in wrist flexors strength at post-treatment in favour of conventional rehabilitation compared to robot-assisted UE training.</p>
Masiero et al., 2007 PEDro score: 6/10	35 patients with acute stroke	<p>UE sensorimotor robotic training (n=17) vs. Control intervention (n=18)</p> <p><u>Treatment program:</u> Robotic training was performed using the <b>NeReBot</b> and consisted of shoulder and elbow movements patterns exercises provided for 20-30 minutes 2 times/day for 5 weeks.</p> <p>The control group used the NeReBot with the unaffected UE for 30 minutes, 2 times/per week.</p>	<p><b>At post-treatment (5 weeks) and follow-up (3 and 8 months post-stroke):</b>            (+) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow + coordination score            (-) Fugl-Meyer Assessment of Upper Extremity - wrist/hand score            (-) Modified Ashworth Scale            (-) Trunk Control Test            (+) Medical Research Council (MRC) - deltoid            (+) Medical Research Council (MRC) - biceps*            (-) Medical Research Council (MRC) - wrist flexors            (+) Functional Independence Measure (FIM) - total score            (+) Functional Independence Measure (FIM) - motor score            * significant between-group difference at 5 weeks and 3 months but not at 8 months.</p>



Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Mehrholz et al., 2012 PEDRO score: N/A (systematic review)	N=666 patients with acute, subacute or chronic stroke (19 RCTs or controlled trials)	Electromechanical and robot-assisted arm training vs. Other rehabilitation or placebo interventions, or no treatment.	<b>At post-treatment:</b> (+) Activities of daily living (+) Arm function (-) Muscle strength (-) Safety and acceptance of therapy
Nef et al., 2009 PEDro score: N/A (single-cases study)	3 patients with chronic stroke	UE robot-assisted training <u>Treatment program:</u> Passive and active robot-training for 8 weeks (subjects 1 and 2 received 3 1-hour sessions per week; subject 3 received 5 1-hour sessions per week) that included shoulder and elbow reaching movements with haptic, visual and sound feedback using the <b>arm exoskeleton ARMin I.</b>	<b>At post-treatment (8 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (3/3 subjects) (-) Action Research Arm Test (-) Barthel Index (+) Active range of motion (AROM) - elbow flexion/extension (subjects 1 and 3) (-) AROM – shoulder abduction (-) AROM – shoulder flexion (-) AROM – transversal abduction (+) Coordination – transversal abduction/adduction (subjects 1 and 2) (+) Coordination – elbow flexion/extension (subject 2) (+) Strength – shoulder flexion/abduction (subject 3) (+) Strength – shoulder extension/adduction (subject 1 and 2) (+) Strength – transversal abduction (subject 3) (-) Strength – transversal adduction <b>At follow-up (16 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity (subject 1)

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(-) Action Research Arm Test (-) Barthel Index (+) AROM- elbow flexion/extension (subjects 1 and 3) (-) AROM – shoulder abduction (-) AROM – shoulder flexion (-) AROM – transversal abduction (-) Coordination – transversal abduction/adduction (-) Coordination – elbow flexion/extension (+) Strength – shoulder flexion/abduction (subject 3) (+) Strength – shoulder extension/adduction (subject 1 and 2) (-) Strength – transversal abduction (-) Strength – transversal adduction.
Norouzi-Gheidari et al., 2012 PEDro score: N/A (systematic review and meta-analysis)	N=425 patients with acute, subacute or chronic stroke (12 RCTs or controlled trials)	Robot-assisted arm training vs. Other rehabilitation or placebo interventions.	<b>At post-treatment:</b> (-) Functional Independence Measure (+) Fugl-Meyer score* <sup>^</sup> (+) Motor Power Scale* <sup>*</sup> (+) Motor Status Score* * when robot-assisted therapy was used in addition to conventional rehabilitation ^ also in subgroup analysis of patients with acute/subacute stroke. * in studies that focused on strength in four proximal muscles of the paretic arm by assessing power in the elbow flexor and extensor and shoulder flexor and abductor muscles.

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
Posteraro et al., 2009 PEDro score: N/A (quasi-experimental study)	20 patients with chronic hemiparesis resulting from stroke or brain injury	<p>UE robot-assisted training</p> <p><u>Treatment program:</u> 45 minutes, 3 times/week for 6 weeks.</p> <p>Goal-directed, planar passive and active-assisted reaching tasks, which emphasized shoulder and elbow movements, moving from the center target to 8 peripheral targets using the <b>MIT-MANUS</b> robot.</p>	<p><b>At post-treatment (6 weeks):</b></p> <p>(+) Motor Status Scale - shoulder/elbow score (-) Pain (+) Passive ROM – shoulder (+) Passive ROM – elbow (+) Modified Ashworth Scale - shoulder (-) Modified Ashworth Scale - elbow</p> <p><b>At follow-up (3 months):</b></p> <p>(-) Motor Status Scale - shoulder/elbow score (-) Pain (+) Passive ROM - shoulder (-) Passive ROM - elbow (-) Modified Ashworth Scale – shoulder (-) Modified Ashworth Scale – elbow</p>
Rabadi et al., 2008 PEDro score: 6/10	30 patients with acute stroke	<p>UE robot-assisted therapy (n=10) vs. Ergometer therapy (n=10) vs. Group occupational therapy (n=10)</p> <p><u>Treatment program:</u> Twelve 40-minute sessions/day and conventional rehabilitation for 3 hours/day.</p> <p>Robot-mediated UE training used the <b>MIT-Manus</b> robot and consisted of performing goal-directed, robot-passive and active assisted arm movements.</p> <p>Ergometer UE training used the Monark arm ergometer (i.e. bidirectional hand cycle) at 0 resistance for an average of 55-60 cycling movements per minute.</p>	<p><b>At post-treatment (12 sessions):</b></p> <p>(-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (-) Fugl-Meyer Assessment of the Upper Extremity – pain score (-) Action Research Arm Test (-) Motor Status Scale - shoulder/elbow score (-) Motor Status Scale - wrist/hand score (-) Functional Independence Measure (FIM) – total score (-) Functional Independence Measure (FIM) – motor score (-) Functional Independence Measure (FIM) –</p>

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		Group occupational therapy UE training consisted of passive and active-assisted range of motion exercises of the shoulder, elbow and hand.	cognition score (-) MRC test of motor power (-) Modified Ashworth Scale
Reinkensmeyer et al., 2012 PEDro score: 6/10	27 patients with chronic stroke	Robot-assisted upper extremity training (n=13) vs. Conventional tabletop therapy (n=14) <u>Treatment program:</u> Robot-assisted UE training was performed during 24 1-hour treatment sessions, 3 times per week for 8-9 weeks and treatment comprised 3-5 repetitions of five therapy 3D games using the Pneu-WREX device. Conventional tabletop therapy comprised range of motion stretches, active range of motion strengthening exercises and activity of daily living tasks with the hemiparetic limb.	<b>At post-treatment (8-9 weeks) and follow-up (3 months):</b> (-) Fugl-Meyer Assessment of Upper Extremity Function (-) Rancho Los Amigos Functional Test of the Hemiparetic Upper Extremity (-) Motor Activity Log - Amount of Use (-) Motor Activity Log - Quality of Movement (-) Box and Blocks Test (-) Grip strength (-) Nottingham Sensory Assessment
Rosati et al., 2007 PEDro score: 7/10	24 patients with acute stroke	UE robot-assisted training (n=12) vs. Limited exposure to robotic device (n=12). <u>Treatment program:</u> Robotic training: 20-25 minutes/session, 2 sessions/day, 5 days/week for 4 weeks using the <b>NeReBot</b> . Limited exposure: 30 minutes/session, 2 sessions/week for 4 weeks, using the unimpaired UE. Both groups also received conventional rehabilitation consisting of occupational therapy and exercises based on Bobath concept.	<b>At 7 weeks post-treatment (3 months post-stroke):</b> (+) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow + coordination score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (+) Motor Status Score - shoulder/elbow score (-) Motor Status Score - wrist/fingers score (-) Pain (+) Functional Independence Measure (FIM) – total score (+) Functional Independence Measure (FIM) -

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			motor score (+) Medical Research Council (MRC) - shoulder flexion/abduction (+) Medical Research Council (MRC) - elbow flexion/extension (-) Medical Research Council (MRC) - wrist flexion/extension
Song et al., 2008 PEDro score: N/A (quasi-experimental study)	8 patients with chronic stroke	Myoelectrically controlled robot-assisted rehabilitation. <u>Treatment program:</u> 20 sessions, 5 times/week for 6 weeks. Training comprised active-assisted and resistive elbow flexion and extension goal-directed exercises using a trajectory tracking screen.	<b>At post-treatment (6 weeks):</b> (+) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (+) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (+) Motor Status Scale (+) Modified Ashworth Scale – elbow (+) Active ROM - elbow extension (+) Maximum voluntary torque - elbow flexion (+) Maximum voluntary torque - elbow extension (+) Tracking accuracy (extension ROM only)
Staubli et al., 2009 PEDro score: N/A (single-cases study)	4 patients with chronic stroke	Robot-assisted upper extremity training using the ARMin II exoskeleton robot (6 DOF moving shoulder, elbow and wrist joints). <u>Treatment program:</u> 3-4 1-hour sessions per week over a period of 8 weeks and included passive assisted and active assisted goal-directed exercises, with visual and auditory feedback.	<b>At post-treatment (8 weeks) and follow-up (6 months):</b> (+) Fugl-Meyer Assessment of Upper Extremity* (+) Wolf Motor Function Test* (-) Catherine Bergego Scale (-) American Spinal Injury Association test (-) Subjective assessment of ADLs tasks, progress, changes, and motivation (-) Maximal voluntary torques

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			*significant improvements observed in 3 of 4 participants
Stein et al., 2007 PEDro score: N/A (quasi-experimental study)	8 patients with chronic stroke	UE training using an EMG-controlled exoskeletal robotic brace <i>Treatment program:</i> 60 minutes/session, 2-3 sessions/week for a total of 18 hours during a 6-9 week period. Patients used the <b>Active Joint Brace</b> robotic device to complete functional UE tasks with active-assistance on elbow flexion/extension.	<b>At post-treatment (6-9 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity Function (+) Modified Ashworth Scale
Vergaro et al., 2010 PEDro score: N/A (quasi-experimental study)	10 patients with chronic stroke	UE robot-assisted training <i>Treatment program:</i> 6-12 1-hour sessions Training consisted of continuous elbow movements following a figure-of-eight-shaped trajectory using the haptic <b>Braccio di Ferro</b> device, performed under haptic and visuo-haptic conditions.	<b>At post-treatment:</b> (+) Fugl-Meyer Assessment of Upper Extremity (-) Ashworth Scale (+) Smoothness of movement (+) Movement accuracy
Volpe et al., 1999 PEDro score: N/A (quasi-experimental study) (3 years follow-up of the Aisen et al., 1997 study)	20 patients with acute stroke (12 patients at 3 year follow-up)	UE robot-assisted training (n=10) vs. Sham robot-assisted therapy (n=10) <i>Treatment program:</i> 1 hour/day, 5 days/week during admission to inpatient rehabilitation. UE robot-assisted training consisted of goal-directed elbow and shoulder movements using the <b>MIT-Manus</b> robotic device. Sham robot-assisted therapy consisted of	<b>At follow-up (3 years):</b> (-) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow + coordination score (-) Fugl-Meyer Assessment of Upper Extremity - wrist/hand score (+) Motor Status Scale - shoulder/elbow score (-) Motor Status Scale - wrist/hand score (-) Motor Power Score (-) Functional Independence Measure (FIM)

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
		weekly or biweekly exposure to the device where the robotic arm was moved actively.	
Volpe et al., 2000 PEDro score: 7/10	56 patients with acute stroke	UE robot-assisted training (n=30) vs. Limited exposure to robotic device (n=26) <u>Treatment program:</u> Robotic training consisted of robot-assisted goal-directed shoulder and elbow movements with auditory feedback using the <b>MIT-Manus</b> device during 1-hour sessions, 5 days/week over 6-7 weeks. Control intervention consisted of 50% of robot-assisted UE training trials performed with the unaffected hand for 1 hour per week over 5 weeks.	<b>At post-treatment (6-7 weeks):</b> (-) Fugl-Meyer Assessment of Upper Extremity - shoulder/elbow + coordination score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (+) Motor Status Score - shoulder/elbow + coordination score (-) Motor Status Score - wrist/hand score (+) MRC test of motor power (+) Functional Independence Measure (FIM) - Motor score (+) Functional Independence Measure (FIM) - Cognition score
Volpe et al., 2008 PEDro score: 6/10	21 patients with chronic stroke	Intensive UE robot-assisted training (n=11) vs. Intensive sensorimotor arm training mediated by therapist (n=10) <u>Treatment program:</u> 18 1-hour sessions, 3 times/week for 6 weeks. Robot-assisted training consisted of planar active and active-assisted goal-directed exercises with the InMotion2 robot ( <b>MIT-MANUS</b> ) The control group received UE training consisting of static stretching, active-assisted arm exercise using the Monark Rehab Trainer and goal-directed planar reaching tasks using the hemi-glide device.	<b>At mid-treatment (3 weeks):</b> (-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score (-) MRC test of motor power - shoulder/elbow score <b>At post-treatment (6 weeks) and follow-up (3 months):</b> (-) Fugl-Meyer Assessment of the Upper Extremity - shoulder/elbow score (-) Fugl-Meyer Assessment of the Upper Extremity - wrist/hand score

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(-) Fugl-Meyer Assessment of the Upper Extremity – pain score (-) MRC test of motor power – shoulder/elbow score (-) Action Research Arm Test (-) Modified Ashworth Scale (-) Passive ROM of 9 muscle (-) Stroke Impact Scale (-) National Institute of Health Stroke Scale (-) Beck Depression Scale (-) Shoulder dislocation
Whittall et al., 2000 PEDro score: N/A (quasi-experimental study)	14 patients with chronic stroke	Bilateral arm training with rhythmic auditory cueing (BATRAC) <u>Treatment program:</u> 18 20-minutes sessions, 3 times/week for 6 weeks. <b>BATRAC</b> device facilitates simultaneous or alternating bilateral passive and active elbow and shoulder movements in the transverse plane.	<b>At post-treatment (6 weeks):</b> (+) Fugl-Meyer Upper Extremity Motor Performance Test (+) Wolf Motor Function Test - performance time (-) Wolf Motor Function Test – strength (-) Wolf Motor Function Test – function (+) University of Maryland Arm Questionnaire for Stroke (-) Shoulder isometric strength (+) Elbow isometric strength (paretic elbow only) (+) Wrist isometric strength (paretic wrist flexion only) (-) Thumb (opposition) isometric strength (-) Grip strength (+) Shoulder ROM (aROM paretic shoulder extension only)



Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
			(-) Elbow ROM (+) Wrist ROM (aROM/pROM parietic wrist flexion) (+) Thumb ROM (aROM parietic thumb opposition) <b>At follow-up (2 months):</b> (+) Fugl-Meyer Upper Extremity Motor Performance Test (+) Wolf Motor Function Test - performance time (-) Wolf Motor Function Test – strength (-) Wolf Motor Function Test – function (+) University of Maryland Arm Questionnaire for Stroke (-) Shoulder isometric strength (+) Elbow isometric strength (non-parietic elbow flexion only) (+) Wrist isometric strength (non-parietic wrist extension only) (-) Grip strength (-) Shoulder ROM (-) Elbow ROM (-) Wrist ROM (+) Thumb ROM (aROM parietic thumb opposition only) Note: + indicates improvement from baseline scores
Zollo et al., 2011	24 patients with chronic stroke	UE training using the <b>InMotion 2</b> (shoulder/elbow) and <b>InMotion 3</b> (wrist) robotic devices.	<b>At post-treatment (12 weeks):</b> (+) Fugl-Meyer Assessment of Upper Extremity

Author, Year PEDro Score, Country	Sample size	Intervention	Outcome and significance: (+) significant (-) not significant
PEDro score: N/A (quasi-experimental study)		<p><u><i>Treatment program:</i></u>            1 hour, 3 times/week for 12 weeks.            Training consisted of goal-directed, active, active-assisted and passive movements of the shoulder and elbow for 6 weeks and of the wrist for 6 weeks.</p>	<p>Function            (+) Motor Power scale            (+) Kinematic and dynamic indices            (+) Motion planning indices</p>