

Effectiveness of Robotic Therapy on Upper Extremity Functioning in Adults With Chronic Stroke: A Systematic Review

Rochelle Mendonca, PhD, OTR/L¹, Namrata Grampurohit, PhD², Brooke Hartman³, Amanda R. O'Connor³, Susan Xing, Carley R. Quirin³

¹Columbia University, Philadelphia, PA, USA; ²University of the Sciences, Philadelphia, PA, USA; ³Columbia University, New York, New York, United States

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Primary Author and Speaker: Rochelle Mendonca, rochelle12@gmail.com

BACKGROUND: Stroke impacts about 795,000 American each year and effects motor and cognitive function of an individual. More recently robotic therapy for the upper and lower limbs is being explored as an intervention for this population. However, the evidence on robotics as an intervention either over or in conjunction with conventional therapy is inconclusive. This study systematically reviews the literature to understand the effectiveness of rehabilitation robotics on upper limb function and pain for adults with chronic stroke.

DESIGN: A systematic review was conducted on six databases (Prospero Registration #CRD42017062254). Inclusion criteria were peer reviewed randomized trials published between 2007 and 2020, adults aged 18 and over, chronic stroke, upper extremity pain and function, and robots. The exclusion criteria were acute or subacute stroke, children, animal studies, nonrandomized and nonexperimental designs.

METHOD: The screening and fulltext retrieval were completed independently by two reviewers in the Rayyan Systematic Review Software. Two additional reviewers were available for conflict resolution. Data extraction included title, author, date, setting, age, time post stroke, type of stroke, inclusion & exclusion criteria, number of participants, study design, robotic intervention description and dose, alternate intervention description and dose, UE function and pain outcomes, and other relevant outcomes. The methodological quality for risk of bias was assessed using PEDro and CONSORT. AJOT guidelines for systematic reviews were applied to determine strength of evidence. The PRISMA guidelines for reporting systematic reviews were followed.

RESULTS: A total of 2,565 articles were retrieved after removal of duplicates. Thirty randomized trials were included for full text review, including twenty with Level 1B evidence with the remaining 10 being level 2B evidence. Among the Level 1B articles, 11 showed significant between group improvements in the robot group compared to control group on UE functional assessments such as the Fugl Meyer (FM), Action Research Arm Test (ARAT), Wolf Motor Function Test (WMFT), and Stroke Impact Scale (SIS). Nine of the Level 1B studies showed significant within group differences for the robot group on the FM, MAL, SMFT, Stroke Impact Scale (SIS), Nottingham Extended ADL Scale (NEADL), and ABILHAND. In the Level 2B studies, 6 showed significant within group differences for the robot group on the FM, SIS, ARAT, MAL, Box and Block Test, Strength and Range of Motion. Four showed significant between group differences on the FM and ARAT. Based on these results, there was strong evidence for the effectiveness (9 Level 1B and 6 Level 2B) of robotic intervention in a chronic stroke population in improving upper extremity functional outcomes. There was also strong evidence for the comparative effectiveness (11 Level 1B and 4 Level 2B) of robotic interventions compared to alternative therapies in this population. Five of the thirty studies reported pain outcomes, however the measurement of pain was inconsistent and there were no differences obtained in pain outcomes. The study also evaluated dosage of the robotic interventions which ranged from 20 to 300 hours.

CONCLUSIONS: This study found that robotic therapy has positive outcomes on function of adults with chronic stroke compared to conventional therapy. However, more research needs to be done to consider how robotic interventions impact function, as well as more research to examine if there is a relationship between pain and robotic intervention for chronic stroke. This study informs the use, effectiveness, and dosage of robotic interventions for rehabilitation of adults with chronic stroke.

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