

# Performance-based selective training for robot-mediated upper limb rehabilitation after stroke

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<b>Registration date</b> 12/06/2018	<b>Overall study status</b> Completed	<input type="checkbox"/> Protocol
<b>Last Edited</b> 22/03/2019	<b>Condition category</b> Nervous System Diseases	<input type="checkbox"/> Statistical analysis plan
		<input checked="" type="checkbox"/> Results
		<input type="checkbox"/> Individual participant data

## Plain English Summary

### Background and study aims

One of the undesirable consequences of stroke is loss of function of a body part, known as motor impairment, which can have lasting harmful impact on daily living activities. A very common consequence of stroke is difficulty in controlling upper limb movements (hand or arm; for example reaching the arm towards an object). Training of the upper limb (for example, via physiotherapy, occupational therapy, robot-mediated therapy) may help to improve upper limb function. However, in many cases recovery of upper limb movement is very limited, despite therapy. Therefore there is a need to develop better rehabilitation methods for the upper limb. This study aims to examine whether recovery of arm movements after stroke can benefit from personalised training in which the set of practiced movements in each exercise run, is selected based on the individual's profile of impaired performance (assessed before the practice run).

### Who can participate?

Adults aged 18 or over who have had a stroke over 6 months previously

### What does the study involve?

Participants are randomly allocated to one of two groups.

Those in the first group train with movements which are selected individually for each participant, whereas those in the second group train with a set of movements which are used in multiple studies about robot-assisted rehabilitation. Participation of each individual is spread out over three months, albeit its main period – which involves most of the robot-assisted movement exercise - is concentrated in 6 weeks.

The first two appointments (two weeks apart) include clinical assessments for upper limb impairment and evaluation of vision and cognitive conditions. These assessments are conducted by an experienced physiotherapist. The results of these assessments indicate eligibility to take part in the rest of the study. For eligible participants the assessments' results are included as part of the research results, to inform about the baseline level of upper limb impairment - before training.

Before the main period of the study eligible participants participate in an MRI scan to inform about brain areas affected by the stroke and their activity.

During the main 6 weeks of the study the participants take part in four robot-assisted exercise appointments every week (except the first week which includes two initial exercise

appointment). Each appointment lasts between 1 and 1.5 hours, including multiple rest breaks. It involves exercise with a range of arm movements. A handle of a robotic device is attached to the affected hand (using a special glove) and if needed, it produces gentle assisting force on the hand to guide its movement and help to complete it on time. The robotic device also records information about the movement performance.

A few days after the end of the main period the participants participate in another clinical assessment appointment and another MRI scan, to evaluate the effect of the exercise on the upper limb impairment and on the brain. The final two follow-up appointments are taken four weeks after the end of the training. One appointment involves final clinical assessment and the other appointment is a final evaluation of performance with the robot-assisted exercises. To evaluate the benefit of our new therapy approach we compare the training effect between the two groups of participants.

What are the possible benefits and risks of participating?

Whilst the study aims to investigate the benefit of a new method of exercise in improving recovery of the upper limb in stroke patients there is no guarantee that participants will receive direct benefit from taking part. However participants may feel satisfied knowing that they contributed to research which aims to improve upper-limb recovery.

MRI scans risks: only MR eligible individuals participate in scan appointments and the regulations of running an MRI scan are kept strictly. Under these conditions the risks are minimal. An MRI scan may not be convenient as it involves lying still inside a narrow tunnel alone without moving. The scan is also very noisy, but the noise level is reduced by wearing ear plugs and ear protection. The participants are provided with a buzzer to press if they feel they need to stop the scan.

Arm movement exercise risks: The intensive exercise can potentially lead to physical or mental fatigue. This is reduced by providing frequent rest breaks. The force provided by the robot is limited to levels which are not harmful. The robot is equipped with an emergency button. In case of sign of distress, the experimenter presses the button which switches off the robot immediately.

People who are highly sensitive to movement of their limb were not included in this study.

Where is the study run from?

School of Psychology, University of Birmingham (UK)

When is the study starting and how long is it expected to run for?

November 2012 – December 2016

Who is funding the study?

1. Medical Research Council (UK)
2. Wellcome Trust (UK)

Who is the main contact?

Dr. Orna Rosenthal (Scientific)  
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## Contact information

**Type(s)**

Scientific

**Contact name**

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**Additional identifiers**

**EudraCT/CTIS number**

**IRAS number**

**ClinicalTrials.gov number**

**Secondary identifying numbers**

RG\_14-017

**Study information**

**Scientific Title**

A comparison of the effectiveness of personalised vs. standard robot-assisted rehabilitation of the upper limb in adults with chronic hemiparesis due to stroke

**Study hypothesis**

1. Both standard and personalised robot-assisted exercise interventions would lead to reduced motor impairment of the affected upper limb
2. The personalised intervention would lead to superior reduction of motor impairment of the affected upper limb, compared to the standard intervention

**Ethics approval required**

Old ethics approval format

**Ethics approval(s)**

Science, Technology, Engineering and Mathematics Ethical Review Committee of the University of Birmingham, 27/03/2014, ref: ERN\_09-528

**Study design**

Single-blinded randomised (stratified) controlled pilot trial

**Primary study design**

Interventional

## **Secondary study design**

Randomised controlled trial

## **Study setting(s)**

Other

## **Study type(s)**

Treatment

## **Participant information sheet**

Not available in web format, please use the contact details to request a patient information sheet

## **Condition**

Upper limb hemiparesis due to stroke

## **Interventions**

Participants are allocated to either test or control study group using stratification (a dynamic minimization protocol), balancing impairment (2 levels: upper-limb Fugl-Meyer scoreless or more than 25), age (two levels: younger or older than 60) and dominance (handedness) of the affected limb (2 levels: dominant or non-dominant) between the groups. Each participant, when recruited and following initial clinical assessment, is allocated to the group which has more factors containing fewer allocations in the stratification levels relevant to that patient. If all three factors are balanced, allocation is based on a pre-set alternating. The stratification is conducted using a computerised algorithm. The clinician who conducts screening and clinical assessment is not informed about group allocation.

For both groups the intervention involves robot-assisted training of the upper limb. In the test intervention group the training is with performance-based selection of upper-limb movements. The principle is based on mapping motor performance across a workspace of point-to-point reaching movements and then selecting movements located at regions of the steepest transition between better and worse performance. In the control intervention group the training is with centre-out movements –a common upper-limb robot-assisted intervention method.

For both test and control intervention groups, the study period is divided to three phases. The initial baseline phase consists of five sessions lasting 1-1.5 hours: two identical clinical assessments (CAs), a robot parameter tuning session, a performance mapping assessment and an MRI brain scan (for MR-eligible individuals). The main training phase comprises four sessions per week for five consecutive weeks. In each week, 3 training sessions are followed by a mapping session. Data from the final mapping session of that phase, and from a following CA (conducted within 2-4 days post-training), serves to evaluate post-training outcomes, and an MRI brain scan (for eligible participants). A final CA and mapping sessions are run 4 weeks later (follow-up phase).

The two groups differ only in the selection of movement conditions during training sessions; all other session types are identical in both groups.

## **Intervention Type**

Other

## **Primary outcome measure**

Upper limb movement is measured by an experienced physiotherapist using the upper-limb Fugl-Meyer (UL-FM) scale (max score: 66), twice before the intervention in two week gap (baseline), few days after the last intervention session (post-training) and 4-weeks later (follow-up).

### **Secondary outcome measures**

1. Muscle power is measured using the MRC Muscle Power scale
2. Spasticity is measured using the Modified Ashworth Scale
3. Everyday motor function is measured using the Motor Assessment Scale
4. Functional independence and performance in activities of daily living is measured using the Barthel index

All of the above are assessed by an experienced clinician (physiotherapist) twice before the intervention in two week gap (baseline), few days after the last intervention session (post-training) and 4-weeks later (follow-up)

5. Levels of robot guidance and assistance were measured using the robot's sensors. These data are recorded automatically throughout all the robot-mediated movement sessions and stored in files on a computer. For outcome, we use the average assistance and guidance forces per movement condition in the following robot-mediated performance assessment sessions: pre-intervention (baseline), few days after the last intervention session (post-training) and 4-weeks later (follow-up)

### **Overall study start date**

01/11/2012

### **Overall study end date**

31/12/2016

## **Eligibility**

### **Participant inclusion criteria**

1. Aged 18 years or over
2. Cortical or capsular stroke >6 months before participation and no evidence for another stroke in the last 6 month
3. FMA-UE score within 5 and 50 points, with no more than 5-point difference on repeat testing at two weeks interval
4. Preserved vision across the visual field, allowing detection of all the stimuli displayed during the robot-assisted motor tasks
5. Ability to maintain balance when seated
6. Preserved basic cognitive function including understanding instruction as assessed by Mini Mental State Examination
7. Available during the full period of the study

### **Participant type(s)**

Patient

### **Age group**

Adult

### **Lower age limit**

18 Years

### **Sex**

Both

**Target number of participants**

24

**Participant exclusion criteria**

1. Prolonged pain in the affected upper limb or during movement assessed using the Likert Pain Scale or injury in the hemiparetic hand/arm
2. Severe spasticity involving elbow/shoulder movements  $\geq 3$  in Modified Ashworth Scale for any tested elbow/shoulder posture
3. Receiving physiotherapy during the study period
4. Cerebellar lesion assessed by MRI or by clinical report as provided by the patient

**Recruitment start date**

22/09/2014

**Recruitment end date**

16/10/2015

## Locations

**Countries of recruitment**

England

United Kingdom

**Study participating centre**

University of Birmingham

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## Sponsor information

**Organisation**

Medical Research Council

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Research council

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**ROR**  
<https://ror.org/03x94j517>

## **Funder(s)**

**Funder type**  
Research council

**Funder Name**  
Medical Research Council

**Alternative Name(s)**  
Medical Research Council (United Kingdom), UK Medical Research Council, MRC

**Funding Body Type**  
Government organisation

**Funding Body Subtype**  
National government

**Location**  
United Kingdom

**Funder Name**  
Wellcome Trust

**Alternative Name(s)**

**Funding Body Type**  
Private sector organisation

**Funding Body Subtype**  
International organizations

**Location**  
United Kingdom

# Results and Publications

## Publication and dissemination plan

Planned publication in a high-impact peer reviewed journal.

## Intention to publish date

01/12/2018

## Individual participant data (IPD) sharing plan

The datasets generated during and/or analysed during the current study are/will be available upon request from:

Dr. Orna Rosenthal (primary researcher): o.rosenthal@bham.ac.uk

Prof. Chris Mial (Project lead): r.c.miall@bham.ac.uk

## IPD sharing plan summary

Available on request

## Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
<a href="#">Results article</a>	results	20/03/2019	22/03/2019	Yes	No