Interactive distance technology enabling home-based motor training for stroke patients

Maria Ehn, PhD\textsuperscript{a}
Susanne Palmcrantz, PhD\textsuperscript{b}

\textsuperscript{a} Robotdalen, Mälardalen University, Västerås
\textsuperscript{b} University Department of Rehabilitation Medicine Danderyd Hospital and Department of Clinical Sciences, Danderyd Hospital, Karolinska Institutet
Parts involved in the project

Danderydsgeriatriken/SLSO
Danderyds sjukhus AB
Landstinget Västmanland
Strokeförbundet
World Stroke Organization
Västerås Stad
Örebro kommun
Örebro läns landsting

Alkit Communications AB
JP Relations AB
Karolinska Institutet
Microsoft AB
Mälardalens Högskola
Robotdalen
SICS Swedish ICT
SLL Innovation
Aim, goal and methodology of the work

Aim
To develop a technical tool, based on interactive communication technology, supporting home-based motor training of stroke patients

Goal
That the developed concept has the potential to become a future product used in stroke rehabilitation

Methodology
Needs-driven and in close co-operation with end-users
Developing and testing the technology

(1) Collection of needs and requirements from end-users

- Workshops
  - (a) patients with stroke
  - (b) persons close to patients
  - (c) occupational- and physiotherapists

(2) Iterative development-testing of technology

- Prototype development (in collaboration with physiotherapists)
- Workshops (testing)
  - (a) Patients + therapists
  - (b) Stroke org + health care professionals

(3) Pilot study

More information on (1) and (2) found in
Overall aim for the technical support

• To support motor function and independence after stroke by enabling
  – Enhanced access for the patient to efficient, continuous training
  – Support for additional training to prevent dips in training activity during the rehabilitation process
  – Enhanced possibilities for follow-up on training results
Use of the technology

- Patients can perform training at home in front of a screen supported by training programs

- Patients can either do the training on his/her own or during video-conference with the therapist

- Support for planning and follow-up of training
Set-up

- Computer
- Web-Camera
- Head-set
- Internet access

- Big screen
- Kinect sensor
- Computer
- Speakers and microphone
- Internet access
Components

HARDWARE
- Standard consumer products

DEVELOPED SOFTWARE
- Computer-based training programs
- Components for video-communication
- Tools for planning and follow-up of training
Computer-based training programs

- Contain selected exercises used by physiotherapists in motor training with stroke patients
- Exercises contain levels with different degree of difficulty
- First version of programs contain six exercises which comprise movements for training four specific motor functions (arm- and leg function and balance/posture)
- Feedback given includes
  - Audio feedback
  - Visual feedback

![BASIC EXERCISE](image1)

![GAMIFICATION EXERCISE](image2)

EXERCISES FOR STAND-UP BALANCE/POSTURE TRAINING
Interaction with the technology

- Exercises and level of difficulty are chosen in advance by therapist at a clinic
- During video-conference, therapist can add/retract exercises and adjust level of difficulty
- Starting up the computer (“power on”)
- Further interaction with the system via the Kinect sensor
  - Selecting an exercise (menu)
  - Using the programs
  - Ending session
Summary

- Technical support for home-based motor training of stroke patients developed in close co-operation with end-users
- Standard hardware products together with software including training programs, components for video-communication and tools for planning and follow-up
- With the support, patients can either do the training on his/her own or during video-conference with the therapist
- Early tests has been performed in workshops with end-users during the technical development
- Feasibility and safety when using the technology as support in stroke rehabilitation further explored in pilot study
DISKO – an interactive distance solution for stroke rehabilitation in the home setting based on modern information and communication technology - a pilot study

Susanne Palmcrantz, Reg Physiotherapist, PhD

Professor Jörgen Borg, Inga-Lill Boman OT, PhD, Disa Sommerfeld PT, PhD, Jeanette Plantin, PT, PhD student, Anneli Wall, PT, PhD student

University Department of Rehabilitation Medicine Danderyd Hospital and Department of Clinical Sciences, Danderyd Hospital, Karolinska Institutet

In collaboration with: Maria Ehn, PhD, Robotdalen, Marie Sjölinder, PhD and Pär Hansson, Swedish Research Institute for Computer Science, Jonas Jalminger, PhD, Alkit Communications AB.
Aim

To explore the feasibility and safety of using DISKO in the home setting when used as a tool in different rehabilitation phases after stroke
Methods

Participants

- 5 participants – discharged home and to neuroteam in primary health care
- 5 participants – living at home and phased out from neuroteams in primary health care
- 5 participants- living at home and with long-term motor impairments
Methods

Inclusion criteria
• Impaired motor function after stroke limiting activities of daily living
• Stand without support > 2 min
• Functional reach >12 cm

Exclusion criteria
• Limitations in following verbal and written training instruction or study information
• Impaired vision preventing orientation and reading instructions on a screen
Methods

• Assessment of functioning and disability
• DISKO installed in the home
• Information and instruction
• Individualised training program
• Training sessions 5 days/week
• Follow-ups by video communication 2/days week
• During 3 weeks
## Data collection

<table>
<thead>
<tr>
<th>Participants</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants with stroke</td>
<td>• Functioning and disability</td>
</tr>
<tr>
<td></td>
<td>• Data from DISKO</td>
</tr>
<tr>
<td></td>
<td>• Interview and questionnaire</td>
</tr>
<tr>
<td>Therapist</td>
<td>• Logbook</td>
</tr>
<tr>
<td></td>
<td>• Interview</td>
</tr>
<tr>
<td>Technician</td>
<td>• Interview</td>
</tr>
</tbody>
</table>
Preliminary results
Participants with stroke (n=14)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean (range)</td>
<td>68 (24-92) years</td>
</tr>
<tr>
<td>Women/Men</td>
<td>7 /7</td>
</tr>
<tr>
<td>Time since stroke onset, mean (range)</td>
<td>3 years (1 month - 9 years)</td>
</tr>
</tbody>
</table>
## Preliminary results

### Participants with stroke (n=14)

<table>
<thead>
<tr>
<th>Assessment tool</th>
<th>Disability</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birgitta Lindmark motor assessment</td>
<td>Impaired control of voluntary movement</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Impaired proprioceptive function</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>7</td>
</tr>
<tr>
<td>Berg Balance Scale</td>
<td>Limited balance</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Mean 44 (SD 15) range 7-56</td>
<td></td>
</tr>
<tr>
<td>NIHSS</td>
<td>Limited communication</td>
<td>3</td>
</tr>
<tr>
<td>Montreal Cognitive Assessment</td>
<td>Impaired mental function</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Mean22 (SD 6) range 11-28</td>
<td></td>
</tr>
</tbody>
</table>
Preliminary results - Logbooks

- All managed the technology
- 3 with assistance
- 13 finalised the training period
- 12 of 15 training sessions were finalised
Preliminary results- Interviews
Participants with stroke (n=14)

- Feed back from therapist important
- Increasing the difficulty of the exercises –motivating
- Training at home-convenient
- Fun but too few exercises
- Placement of start button and design of the menu –difficult
- Perform exercises –easy to understand
Preliminary results - Interviews
Therapist and Technician

No negative side effects/risks identified

Low quality of internet access

Technical development areas related to design and functionality of the
• computer based training program
• component for video communication
• tool for planning and follow up of training
Conclusion

• DISKO is safe and feasible to be used as a tool for continuous, prolonged and/or recurrent training of motor function after stroke in the home setting.

• Further development of the technology and of evidence based training exercises are ongoing and thereafter a larger scale study will explore the effects of using DISKO for training in different phases after stroke.
Thank you for your attention