Stroke

Is it a stroke?
Check these signs FAST!

Face
Does the face look uneven? Ask them to smile.

Arm
Does one arm drift down? Ask them to raise both arms.

Speech
Does their speech sound strange? Ask them to repeat a phrase.

Time
Every second brain cells die. Call 9-1-1 at any sign of stroke.

Call 9-1-1 at any sign of stroke.
Stroke symptoms

- Disturbed neurological functioning
  - Motor symptoms
  - Sensory problems
  → Hemiparesis

- Further alterations
  - Cognitive
  - Psychological
  - Emotional
Stroke rehabilitation

- Improvement after stroke:
  - Spontaneous recovery
  - Optimal restoration for functional independence through rehab

- Essential elements:
  - Active movement
  - Intensive training
  - Functional tasks
  - Motivation
  - Feedback
Demographic developments

- Ageing of population
  - Increase in older people
  - Increase in chronic illness
  - Decrease in people providing healthcare

- Preferred stroke rehab is highly labour-intensive
  - Relief (in part) by application of rehab technology
Robotics for arm rehabilitation
Effect of robot-aided therapy

- Systematic review
  - Robot-aided training for proximal arm
    - 8 clinical trials
    - 2 controlled clinical trails

However: which robotic modality is (most) effective?

Prange et al. 2006
Underlying mechanisms

Abnormal coupling after stroke
- Involuntary coupling of shoulder and elbow (Beer et al. 2000)
  - More involuntary elbow flexion with stronger shoulder elevation
- Limited range of motion (Beer et al. 2004)
  - Reduced elbow extension
- Role for arm support?!
Arm support

- Facilitating active movements
- Compensation of arm weight
- Via ideal spring mechanism
- 3D compensated work area
- Relatively simple device

Stienen et al. 2009
Direct influence

- Larger work area (less muscle activity) with arm support

Healthy person

WITHOUT and WITH arm support

Stroke patient

Stienen et al. 2007
Reach training with arm support

- 8 chronic stroke patients
  - FM range: 7 – 61 points
- 6 wk 3x30min sessions
- Reaching exercises
- Interactive game
- Pre-post evaluation of
  - Arm function
  - Maximal reach

Prange et al. 2012
Gaming environment
Changes in work area

- Unsupported work area increased (>100%)
- Together with muscle activity of prime movers

Krabben et al. 2012
Prange et al. 2012
Changes in arm function

- Generally increase in arm function (some patients more than others)

Fugl-Meyer test

Prange et al. 2012
Remarkably...

Robotics and arm support showed comparable effect on arm function

Sanchez 2006
Amirabdollahian 2007
Housman 2009
Prange 2012
- Ferraro 2003 (14)
- Fasoli 2004 (15)
- Stein 2004 (16)
- Burgar 2000 (14)
- Lum 2002 (16)

Prange et al. 2006
ROBAR study

- RCT of 68 patients (7 NL centres)
  - Conventional vs. arm support
  - 6 weeks of 18x 30 min. training

- Increase in arm function after arm support training = conventional training
Other findings ROBAR

- User experiences
  - Positive scores (≥ 5 out of 7)
  - Success factors/bottlenecks
- Estimation of costs/benefits
  - ‘Break even’ at 44 p/year
Opportunities

• Arm support suitable for:
  - Stimulating active arm movements (direct)
  - Enhance arm function after stroke (training)
  - Suitable application for clinical practice
    • Relatively simple/cheap technology
    • Accepted by healthcare professionals & patients!
In clinical practice
Future possibilities

- Benefits of rehabilitation technology:
  - Allow independent practice by patients
  - Less supervision by therapist required
  - Intensive treatment (better) possible

- Care at home
  - Monitoring status
  - Training at home
  - Remote supervision

>> SCRIPT project (FP7)
And thank YOU for your attention!