Robotic-assisted devices in the upper limb
Neurorehabilitation

Stefan Ortmann, MSc, OT

Basel 06.09.2018
Agenda

- Robotic
  - Historical background
  - History and overview of robotics in neurorehabilitation

- Evidence of Robotic-assisted training of the upper extremity
  - Advantage therapy robot & critical review
  - What do Guidelines say

- What to expect in the future
Robotics – History

Leonardo’s robot, da Vinci, 1495

Writing machine, Jaquet-Droz, 1770
History of robotic rehab of the upper extremity

1920  «Helparm»  Movement therapie

1961  «Unimate»  first robotic Arm

1991  «MIT Manus»  first therapeutic robotic arm

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Robotics in the Neurorehabilitation

- Efficiency
- More intensive therapy in severe and very severely affected patients
- Benefit of prestige: For many Patients a Modern and new concept
- Set up time (complex robots)
- costs

06.09.2018
robotic-assisted therapy as group-therapie
Positive cost-benefit-effect \textit{(Hesse et.al.)}
<table>
<thead>
<tr>
<th>Studien ID</th>
<th>Therapiedauer</th>
<th>Häufigkeit und Intensität der Therapie</th>
<th>Gerät</th>
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*Mehrholz et. al.*
Improvement of everyday functions
## Improvement of hand/arm function

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<th>Treatment SD</th>
<th>Treatment Total</th>
<th>Control Mean</th>
<th>Control SD</th>
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<td>0.18 [−0.66, 1.02]</td>
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**Total (95% CI)** 597 569 100.0% 0.39 [0.23, 0.55]
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<th>Treatment</th>
<th>Control</th>
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**Total (95% CI):**

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<td>295</td>
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Heterogeneity: Tau² = 0.55; Chi² = 86.07, df = 17 (P < 0.000001); I² = 80%
Test for overall effect: Z = 2.75 (P = 0.006)

**Risk of bias legend**
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of outcome assessment (detection bias)
(D) Selection reporting (reporting bias)

*Improvement of hand/ arm strength*
Conclusions:

“[...] There is still significant need to improve efficiency and reduce cost of home-based devices for therapy and ADLs assistance. The effectiveness of robotic over conventional therapy is arguable and the best therapy strategy is still not clear. The situation may change soon, because more and more devices are being commercialized and more scientific results will be available. [...]”
„Robot-Assisted Training for the Upper Limb after Stroke“ in GBR

recruitment of 762 patients untill the end of April 2018

Complete support of the National Health Service, (NHS)
  - robotic-assisted therapy, three times a week over 12 weeks
  - additional therapy for the upper extremity without robotics, three times a week over 12 weeks
  - for NHS usual therapy (no additional therapy)
Guidelines for Robotic-assisted Training

- Guidelines AHA
  - Further studies needed to develop optimal test protocols

- Guidelines DGNR
  - Grade of Recommendation B for Armrobot. therapy
Advantage therapy robot

- Safe method in the early phase of rehabilitation (set-up)
- Clinically appropriate outcome-measure
- Many ways to treat
- Support functional restoration
- Apply as 'add-on' exercise equipment
Critical review of robotic evidence

- Evidence
  - Correct therapeutic window (first days)
  - Uneligible study design (quantity, power, etc.)
  - Inhomogeneous patient selection

- Therapie
  - Underchallenging
  - Not variable enough
  - Therapist can not "feel" patient with the help of the robot
  - There are no «optimal» training protocols at present
Summary

We still do not know how to perform a robot-guided workout optimally, but therapy robots have many benefits...
Take Home Message

- The sooner the patient can start rehabilitation, the better
- „Intensity matters“: Intensity and repetition
- Task- and phase-specific training enables the best possible recovery of motor properties
- Targeted, consistent and structured training with help of an individual treatment plan is clinically relevant
Outlook for the future

- Therapeutic approach
- Choice of exercise
- Dose
- Intensive and acute patients
- Integration
- Implementation of study results
Outlook for the future

- interact more with humans themselves via different interfaces
- Exploring the problems adapting of the requirement to specific patients
- Robots which recommend the user to use a different device
- meaningful robot-assisted applications for all patient groups
Thank you very much for your attention!

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