Quantitative 3D kinematic analysis of upper extremity in stroke

Margit Alt Murphy
PhD, Reg. Physiotherapist
Inst. for Neuroscience and Physiology
Sahlgrenska Academy
Gothenburg University, Sweden
Kinematics
Describes movements in space and time

Most common measures in UE
Movement velocity and duration – 71%
Movement smoothness – 58%
Joint angles and trunk displacement – ca 50%

Most common technologies used
Optoelectronic camera systems - 83%
Electro-magnetic systems - 17%
Ultrasound systems - only few studies

Alt Murphy et al. PT Reviews 2015
Kinematic analysis of the upper extremity after stroke

Alt Murphy, Häger C. Kinematic analysis of the upper extremity after stroke - How far have we reached and what have we grasped? Physiotherapy Reviews 2015, in press
Opto-electronic systems

ARMLAB
5 camera system
3-D animation

Normal movement pattern

Movement pattern after stroke
Velocity profiles

Healthy

Movement time: 6s
Movement units: 4

Stroke

Movement time: 16s
Movement units: 35
What should we measure?

95% of the total variance was explained by two major conceptual measurement constructs.

Principal Component Analysis - PCA
Alt Murphy 2013
Association with clinical instruments

Kinematics

Movement smoothness (Movement time) 37%

Compensatory trunk displacement 11%

67%

ARAT
Action Research Arm Test

Alt Murphy et al. NNR 2012, 26(9):1106-1115
Change in kinematics was compared to the clinical improvement in ARAT ≥ 6 points (10%)
- ROC curve analysis
- Regression analysis

- Movement time
- Smoothness
- Trunk displacement

are responsive measures

Alt Murphy et al. NNR 2013
Conclusions

Clinically valid, reliable and responsive kinematic measures

Movement time is strongly correlated with movement quality - smoothness

Trunk displacement summarizes well the compensatory movement patterns
**Recommendations**

Purposeful functional tasks

Select valid, reliable and responsive kinematics:

- Movement time
- Smoothness
- Movement pattern: trunk displacement

Action Research Arm Test (ARAT) correlates strongly with kinematics

Timed standardized testing provides indirect information of movement quality
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Margit Alt Murphy
PhD
Gothenburg University
University of Gothenburg • Department of Clinical Neurosciences

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margit.alt-murphy@neuro.gu.se