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Assessment protocol to quantify upper limb impairment in stroke and cerebral palsy

L. van der Velden¹, J. Benner², C. Haarman³, B. Onneweer¹, M. Roebroek², G. Ribbers², R. Selles²

¹Rehabilitation Medicine, Erasmus Medical Center, Rotterdam, Netherlands

²Rehabilitation Medicine, Erasmus Medical Center, Rotterdam, Netherlands

³Hankamp Rehab, Enschede, Netherlands

Introduction: Several robotic devices have been developed to obtain reliable, valid and operator-independent measurements of upper limb function to overcome the limitations of clinical assessment tools. With these devices, however, generally only one or two impairments are quantified simultaneously, such as only spasticity and changes of viscoelasticity or only abnormal synergy.

Main objective: To develop an assessment protocol to quantify the impaired upper extremity function in terms of muscle weakness, spasticity, abnormal synergy and changes of viscoelastic properties around the elbow with a single device in stroke and adult cerebral palsy (CP).

Methods: Measurement protocols in literature were reviewed, combined and adapted for an assessment protocol to quantify impaired upper extremity function using a shoulder-elbow-perturbator (SEP) in combination with electromyography (EMG).

Results and discussion: Varying the arm support levels and different tasks (passive and active tasks) enable us to distinguish all four impairments for the elbow in stroke patients and adults with CP. The output of the SEP in combination with EMG is measured in terms of torques, angular rotation, and muscle activation. Both signal analysis and system identification techniques were applied to translate the measured data into meaningful variables describing upper limb impairments.

Conclusion: Based on literature, we propose an assessment protocol for the SEP that is operator-independent and can quantify muscle weakness, spasticity, abnormal synergy and changes of viscoelastic properties around the elbow in stroke and CP.

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