

assessment using standard clinical scales.

Project supported by Labex SMART (supported by ANR within the “Investissements d’Avenir programme” ANR-11-IDEX-0004-02).

<http://dx.doi.org/10.1016/j.rehab.2014.03.651>

CO06-007-e

### Validation of instrumental indices for the upper limb function assessment in neurological patients

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**Keywords:** Upper limb; Assessment; Stroke; Robotics

**Background.**– We previously developed software to enable Armeo<sup>®</sup>Spring in assessing reaching movements through indices of accuracy, velocity and smoothness. In this study we tested concurrent validity of these indices by comparing them to Wolf Motor Function Test (WMFT).

**Methods.**– Sixteen stroke patients were enrolled. Residual upper limb function was assessed at admission and after 12 rehabilitation sessions through: WMFT score and time and the numerical indices computed by software on 3D end-point trajectory during “Vertical Capture” task. Four indices assessed accuracy: global Hand Path Ratio (HPR), local HPR in the area of the target, vertical and horizontal overshoot. Two indices assessed velocity: maximum and mean velocity. Three indices assessed smoothness: mean/maximum velocity ratio, number of peaks in velocity profiles and normalized jerk. These indices were compared to WMFT score and time by the non-parametric Spearman’s correlation coefficient.

**Results.**– Thirty-two instrumental assessments on 16 subjects were considered. One accuracy index (HPR), both velocity indices and all smoothness indices were correlated with WMFT score and time. Moreover, these indices have been able to identify problems of accuracy, speed and fluidity in patients with same WMFT score.

**Conclusion.**– Instrumental indices are validated as evaluation tool of reaching movements in stroke.

<http://dx.doi.org/10.1016/j.rehab.2014.03.652>

CO06-008-e

### An analysis of sensitivity to change of a functional scale of the upper limb: UL-ADL

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**Keywords:** Upper limb; Hand; Functions; Scale; Sensitivity

**Objective.**– The UL-ADL scale analyzes the difficulties of hemiplegic patients in active and passive functions of the upper limb in daily life (questionnaire) and test situations. We analysed its sensitivity to change.

The scale was presented before the 8th week after stroke and after a time of 4–12 weeks. The change was analysed by classical indexes of change and the sensitivity/specificity with respect to a predefined criterion (an increase in the Motor Index > 20/100).

**Results.**– The standardized response mean (questionnaire: 0.86; test: 0.71) showed a moderate to good sensitivity, greater than the effect size (0.66, 0.49). These indexes were comparable to those of the Rivermead scale (0.91; 0.63). The area under the ROC curve (sensitivity/specificity) was relatively large, but comparable to that of the Rivermead scale. Correlations were strong ( $P < 0.0001$ ) between changes in UL-ADL scores and the Motor Index.

**Conclusion.**– The UL-ADL scale showed an overall sensitivity similar to that of the reference tests. But in this population, the change was variable and often absent.

<http://dx.doi.org/10.1016/j.rehab.2014.03.653>

P340-e

### Information throughput quantifies heterogeneity of upper-limb workspace post-stroke

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**Keywords:** Stroke; Fitts’ law; Motor control; Information throughput; Upper-limb

**Objective.**– Stroke patients have a diminished capacity to reach targets direct and precisely. The information throughput in the sensorimotor system, as quantified by Fitts’ law for fast and accurate pointing [1], may provide a different way to understand difficulty of motor control post-stroke.

**Methods.**– Thirteen hemiparetic post-stroke patients and 12 healthy controls performed a Fitts’ pointing task. Movement direction, target width and distance varied. Information throughput and kinematics quantifying movement quality were compared between groups and over directions.

**Results.**– Hemiparetic movements were slow, segmented and indirect. Kinematics differentiated between inward and outward movements, whereas information throughput differentiated between sides of workspace, with a lower throughput for the paretic workspace. Kinematic measures were loosely linked to the information throughput.

**Conclusion.**– Movement kinematics captured a different aspect of motor control than information throughput. We propose that kinematics reflect the outcome of adaptations to neuromotor noise, whereas the information throughput quantifies the extra burden necessary to overcome the neuromotor noise. Therefore, information throughput may provide a complementary assessment to adapt rehabilitative gaming exercises to the capacity of the patient.

**Reference**

[1] Fitts PM. The information capacity of the human motor system in controlling the amplitude of movement. *J Exp Psy* 1954;47:381–91.

<http://dx.doi.org/10.1016/j.rehab.2014.03.654>