Bimanual coordination in stroke recovery: Kinematic analysis provides open leads to individualize upper limb rehabilitation

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Objective.—Better understanding how bimanual coordination evolves during the first weeks of natural recovery after stroke is needed. Studying kinematics of grasping movements could allow identifying how patients can be expected to benefit from bimanual rehabilitation.

Methods.—Fifteen patients were included (mean age 64.9) less than thirty days after a first unilateral ischemic/hemorrhagic stroke. Seven kinematic assessments were performed once a week for 6 weeks and a follow-up assessment 3 months after inclusion. The grasping task was performed through 3D-movement analysis in three different conditions: unimanual with the non-paretic limb (UN), unimanual with the paretic limb (UP) and bimanual (BN/BP).

Results.—We found that after 3 weeks of recovery, differences between the two hands tended to disappear, the kinematics of the paretic limb matching those of the non-paretic limb in bimanual condition. Inter-limb coordination as reflected by comparison of kinematics in bimanual movements (NPV, MT, TPV) seemed to be effective about 6 weeks after stroke. Temporal delay between hands at movement onset (ΔBEG) was constantly longer than at movement end (ΔEND).

Discussion.—These results revealed that there seems to be a period when bimanual coordination is optimized, indicating a possible beneficial effect of bimanual rehabilitation around 6 weeks after stroke. We proposed that bimanual programs could be started at the end of the second month among recovery. Moreover, inter-limb coordination was disrupted at movement onset but was preserved at movement goal. This catching up suggests that patients preserved some flexibility consecutively to the impaired temporal performance of the affected hand to achieve the end goal [1]. This disorder in limited movement initiation could be specifically retrained during rehabilitation [2].

References

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A new gait machine G-EO for stair climbing and descending in non-ambulatory neurological patients

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End-effector based gait machines (e.g. the electromechanical Gait Trainer GT I) have proven effective in the restoration of gait in subacute stroke patients. Harness-secured patients can practice several hundred steps during one session without overstressing the therapists. The repetitive practice of stair climbing, highly relevant in everyday mobility, is not possible, however. Accordingly our group designed a novel gait robot, the G-EO (lat.: je marche), whose foot plates are fully programmable enabling not only simulated floor walking but also stair climbing up and down. In addition, integrated 3D force sensors allow human–machine interaction, virtual reality intends to increase the patients’ motivation. Biomechanical studies in ambulatory hemiparetic patients have shown a corresponding lower limb muscle activation pattern during both the real and simulated walking on the floor and stair climbing up and down. A first clinical study in 30 subacute, non-ambulatory hemiparetic stroke patients compared physiotherapy vs. locomotor training on the device + physiotherapy, the intensity was comparable in both groups. The results indicated a superior stair climbing ability in the locomotor group. Large-scale clinical studies will follow.

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