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) tended to disappear, the kinematics of the paretic limb matching those of conventional general training with physiotherapist, with monitoring of heart rate. Before and after each session, tempo-spatial gait parameters were recorded by Gait Rite, and the rate of perceived exertion was quantified by Borg scale. The primary outcome was the gait symmetry evaluated by the symmetry ratio of step length, intra-limb ratio of swing/stance time, and base support. The secondary outcome was the gait velocity.

Conclusion.-- It appears that there are the same quantitative and qualitative post-effect on vascular hemiplegic’s gait pattern, after a single session of Gait Trainer and after one conventional over-ground training. The tolerance is identical. The study confirms the interest of repetitive gait training in stroke patients.


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.