

nou D. Humans use internal models to construct and update a sense of verticality. *Brain* 2010;133:3552–63.

doi:10.1016/j.rehab.2011.07.317

CO32-005-EN

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

J. Metrot<sup>a,\*</sup>, D. Mottet<sup>b</sup>, I. Relave<sup>b</sup>, H.-Y. Bonnin<sup>c</sup>, J.-Y. Pelissier<sup>c</sup>, L. Vandokkum<sup>b</sup>, K. Torre<sup>b</sup>, I. Laffont<sup>d</sup>

<sup>a</sup> *Laboratoire Movement To Health (M2H), EuroMov, 700, avenue du Pic-Saint-Loup, 34090 Montpellier, France*

<sup>b</sup> *Laboratoire Movement To Health (M2H), EuroMov, universit  Montpellier I, Montpellier, France*

<sup>c</sup> *Centre m dical Grau-du-Roi, CHU de N mes, N mes, France*

<sup>d</sup> *Service de m decine physique et de r ducation, CHU de Montpellier, Montpellier, France*

\*Corresponding author.

**Keywords:** Bimanual coordination; Upper limb recovery; Kinematics; Stroke; Prehension

**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 ( $\Delta$ BEG) was constantly longer than at movement end ( $\Delta$ END).

**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

[1] Riek S, Tresilian JR, Mon-Williams M, Coppard VL, Carson RG. Bimanual aiming and overt attention: one law for two hands. *Exp Brain Res* 2003;153(1):59–75.

[2] Wu CY, Chou SH, Chen CL, Kuo MY, Lu TW, Fu YC. Kinematic analysis of a functional and sequential bimanual task in patients with left hemiparesis: intra-limb and interlimb coordination. *Disabil Rehabil* 2009;31(12):958–66.

doi:10.1016/j.rehab.2011.07.318

CO32-006-EN

### Comparative study on post-effect after Gait Trainer and after over-ground training in gait symmetry in stroke patients

*Service de MPR, CHU de Limoges, avenue du Buisson, 87000 Limoges, France*

\*Corresponding author.

**Keywords:** Gait Trainer; Over-ground training; Post-effect; Hemiplegia; Stroke

**Objectives.**– To evaluate the effect of a single session of Gait Trainer in comparison with the effect of a single session of conventional over-ground training, on gait temporo-spatial parameters in post-stroke hemiplegic patient.

**Methods.**– Prospective cross-over study performed during 6 months, in a neurovascular rehabilitation unit. Population was hemiplegic patients with recent or chronic stroke, who had recovered gait autonomy (FAC  $\geq$  2). Patients were their own control and received, 24 hours apart, one session of Gait Trainer and one session of conventional gait training with physiotherapist, with monitoring of heart rate. Before and after each session, temporo-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.

**Results.**– Thirty-eight patients were included. Sessions of Gait Trainer and sessions of over-ground training were comparable in term of walking time, heart rate elevation, and rate of perceived exertion (mean Borg = 12.4 after GT, and 11.9 after over-ground training). A single session of GT improves significantly the gait symmetry ( $P=0.0006$  for step length symmetry ratio;  $P=0.0008$  for SW/ST symmetry ratio) and the gait velocity (+7.7 cm/s,  $P=0.0015$ ). Likewise, one session of conventional over-ground training increases step length symmetry ratio ( $P=0.0067$ ), SW/ST symmetry ratio ( $P=0.0008$ ), and gait velocity (+5.5 cm/s,  $P=0.0233$ ). There is no significant difference of these improvements between Gait Trainer and over-ground training.

**Conclusion.**– It appears that there is 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.

doi:10.1016/j.rehab.2011.07.319

CO32-007-EN

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

C. Werner<sup>a,\*</sup>, A. Waldner<sup>b</sup>, C. Tomelleri<sup>c</sup>, S. Hesse<sup>d</sup>

<sup>a</sup> *Charit  – University Medicine Berlin, Medical Park Berlin, An der M hle 2-9, 13507 Berlin, Germany*

<sup>b</sup> *Villa Melitta, Bozen, Germany*

<sup>c</sup> *Villa Melitta – Reha-Technologies, Bozen, Germany*

<sup>d</sup> *Medical Park Berlin, University Medicine Berlin, Berlin, Germany*

\*Corresponding author.

**Keywords:** Stroke; Hemiparesis; Gait rehabilitation; Robotics; Stairs

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.

doi:10.1016/j.rehab.2011.07.320