References


CO32-002–EN

Place of rTMS in rehabilitation
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Keywords: Transcranial magnetic stimulation; Brain plasticity

Transcranial magnetic stimulation (TMS) is a technique for noninvasive brain stimulation used in humans. The sudden change of a magnetic field can induce an electric current in nerve tissue and depolarize the axons of neurons in the motor cortex. This technique was first used to study the plasticity of the motor cortex with the production of brain mapping and to quantify the excitability of different brain areas. More recently, repetitive transcranial magnetic stimulations (rTMS) have demonstrated their ability to modulate cortical plasticity. rTMS is applied to repeated stimulation at a variable frequency from 1 to 50 Hz for periods of 1–30 min. The nature of the resulting post-effects of this stimulation depends on the frequency, intensity and temporal organization of stimuli. Stimuli applied at a frequency of 1 Hz are most often responsible for a sustained decrease in the excitability of the motor cortex, whereas higher frequencies lead to an opposite result. Because rTMS can modulate brain activity, it has been used at least in a single session in many diseases. The results of these studies open the most opportunities for the use of this new therapeutic tool in neurorehabilitation. Nevertheless there are studies in a single session mostly on intermediate standards (electrophysiology) and not on clinical criteria. The extension of this method of brain stimulation thus requires further, multicenter double-blind randomized versus sham trials to study their influence on clinical criteria of recovery. As such it is essential that teams of physical medicine and rehabilitation may be involved in this validation for the passage of what is still an experimental concept to an actual therapeutic application.


CO32-003–EN

Transcranial direct current stimulation associated with physical therapy after stroke: Feasibility of a prospective, randomised, double blinded, sham controlled study
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Keywords: Hemiparesis; Stroke; Cerebral stimulation; tDCS; Prehension

Introduction.– Transcranial direct current stimulation (tDCS) has been proposed in pilot studies for the treatment of different deficiencies following stroke [1,2]; the presented results were very encouraging, especially for studies with repeated sessions [2]. In fact, tDCS can modulate plasticity following stroke, and can promote the injured hemisphere in the interhemispheric competition. tDCS is easy to perform, its cost is low, and the feasibility of a blinded study is much easier with tDCS than with other cerebral stimulation methods.

Objectives.– To evaluate the feasibility of a study for stroke patients, that would associate tDCS stimulation with physical therapy of the upper limb, in order to evaluate its effects on the affected upper limb function.

Methods.– Prospective, randomised, sham controlled, double blinded study. The upper limb function evolution (Jebsen Taylor Test, Fugl Meyer, Box and Block test, Grip strength) and the autonomy (FIM) in two groups of stroke patients was evaluated. The real or sham stimulation was performed daily during a physical therapy session for 10 consecutive days.

Results.– Six patients were included. 1 patient could easily determine he had a real stimulation: 1 patient did not tolerate the stimulation and withdrew from the experiment. No other adverse reaction was noticed. All the included patients had better performances after the intervention. The stimulations were easy to perform and did not perturb de physical therapy session.

Discussion–Conclusion.– Feasibility of a study with enough power is demonstrated. The number of patients has to be increased in order to statistically compare performance in the two groups.

References


CO32-004–EN

Neural bases of Aubert effect and prospects in rehabilitation
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Keywords: Visual vertical; Stroke; Aubert effect

Introduction.– The Aubert effect [1] is a tilt of visual vertical (VV) towards the body during lateral body tilt. Interpretation refers to internal model of verticality, with greater reweighting of somesthetic graviception upon vestibular graviception. To date, presence of a synthesis of somaesthetic and vestibular graviception has not been proved, and its neural bases have not been analysed. This was the aim of this study.

Materials and methods.– Fourteen paraplegic subjects (T4-T12 ASIA A), 23 hemispheric subjects (unique hemisphere stroke) and 39 control subjects were studied. VV was assessed in upright sitting position and in laterally-tilted postures (50° for paraplegics, 30° for hemiplegics). In hemiplegics, hypoesthesia was quantified and cerebral lesion location was analysed.

Results.– Upright, VV was accurate, but more variable in paraplegics than in controls. This indicates that the somaesthetic graviception contributes to the sense of verticality, even in upright position. As expected, a spontaneous contralesional VV tilt (−4.7 ± 4.7° ; P < 0.001) was found in hemiplegics. Lateral tilts induced Aubert effect in controls (average = 5°), whereas it was abolished in paraplegics. This means there is a modulation of VV by somesthaesic informations.

In hemiplegics, Aubert effect was decreased during contralesional tilt, proportionally to hypoesthesia degree (r = −0.55; P < 0.01). This gradient proves the existence of a synthesis of vestibular and somaesthetic graviceptions. Anatomical analysis showed that this synthesis was made in the posterolateral thalamus (P = 0.003). Interestingly, ipsilesional tilt in hemiplegics normalized VV (−4.7 ± 4.7° vs 1.1 ± 4.5°; P < 0.01).

Discussion–Conclusion.– The Aubert effect results from a synthesis of vestibular and somaesthetic graviceptions, in which the posterolateral thalamus plays a major role [2]. Aubert effect could be useful in clinical practice: ipsilesional tilt may readjust VV in hemiplegics. Whether this improvement lasts together with its positive effects on balance need to be studied.

References


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

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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 a first unilateral ischemic/hemorrhagic stroke. 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.

References


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

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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 of a single session of Gait Trainer in comparison with the effect of a single session of conventional over-ground training, on gait tempo-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 ≥ 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, 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.

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.

References


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

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

Objective.— 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 tempo-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 ≥ 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, 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.

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.