Impairment of coordination during bimanual arm swinging in adults with hemiparesis

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Abstract Title: Impairment of coordination during bimanual arm swinging in adults with hemiparesis.

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A strong interhemispheric interaction accompanies rhythmical bimanual movement. The perturbation of one arm during swinging results in a disruption of bimanual coupling (phase change) in healthy subjects. We hypothesized that bimanual coupling may be impaired following stroke due to changed interhemispheric interaction and/or neuromuscular properties. While standing, healthy subjects and patients with hemiparesis swung their arms reciprocally (anti-phase) for 15s per trial (12 trials). Movement of one arm was unexpectedly and transiently (150 ms) arrested once in the forward and once in the backward phase of swinging at approximately –10 deg with respect to mid-swing. Perturbations were applied to the right and left arms in healthy subjects and to the paretic, and non-paretic arms in patients. Kinematic and EMG data (shoulder muscles) were recorded. The oscillatory period, inter-arm phase differences and mean EMG before, during and after perturbation were compared. In healthy subjects, perturbation prolonged the cycle period in both the arrested and non-arrested (free) arms in the perturbed cycle. In contrast, in patients, arms moved with different frequencies after the perturbation, regardless of which arm was arrested and regained pre-perturbation anti-phase synchrony after a few cycles. While healthy subjects had no preference in terms of the lead arm following perturbation, patients preferably used the non-perturbed arm (paretic or non-paretic) to correct the movement. The pattern of shoulder muscle coactivation was changed in the paretic arm when the paretic arm was arrested. Results suggest that patients with stroke preserve the ability to synchronize bimanual movement but that the ability to make rapid corrections is disrupted. Our findings

also suggest that the paretic arm is actively involved in the process of preservation of bimanual coordination.

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