117 - The Control of Trunk Movements after Tripping

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Introduction: Trips and slips are the most prevalent causes of falls in both young and older adults. A successful recovery of a trip implies that the forward rotation of the body is sufficiently reduced. Given the large mass of the trunk, adequate control of the trunk momentum is crucial in this respect. The aim of the present study was to establish which trunk movements occur after tripping and how these movements are controlled by the activity of hip and trunk muscles.

Methods: Ten males (42 (SD 3.7) years) repeatedly walked over a platform in which 21 obstacles were hidden. Each subject was tripped over one of these obstacles during mid-swing of the right foot in at least 5 trials. Kinematics, dynamics and muscle activity of the major hip and trunk muscles were measured. To determine obstacle contact, the A-P acceleration of the obstacle was measured. The instant of landing after the trip was determined from the ground reaction force.

Results: After a trip, trunk flexion increased due to the impact with the obstacle (extra flexion 17°, SD 2.4°). In addition, displacements outside the saggital plane occurred (9° (SD 3.5°) right rotation, 1° (SD 0.8°) lateral bending).

In response to tripping, co-activation of the abdominal and trunk muscles was seen. This reduced the flexion movement of the trunk before the foot was placed on the ground for almost all subjects, indicated by a negative (=extension) or zero trunk angular velocity at landing. Subjects appeared to anticipate the landing of the blocked foot by increasing especially the activity of the erector spinae muscles. In most subjects, this anticipation was adequate, as no increase in trunk flexion was seen due to the impact force at landing. In trials where subjects showed an increased trunk flexion after landing, the ground reaction force was directed posterior of the L5S1 joint, which causes a large flexion moment on the trunk.

Conclusion: After tripping, large trunk movements were seen outside the saggital plane. The trunk muscles co-contract in response to the impact with the obstacle to brake or even reverse the trunk movement. Trunk movements at landing are controlled by specific anticipation of trunk muscle activity and by proper placement of the foot.

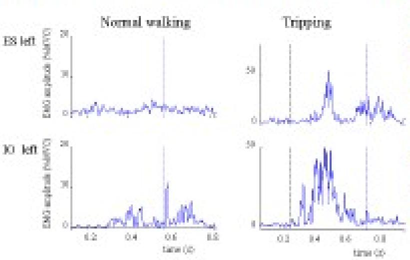

Fig 1: Trunk muscle activity of a typical subject in normal walking and tripping. Both time series started at toe off of the right foot. The dashed line represents the instant of tripping. The dotted line represents the instant of landing. (ES = erector spinea muscles, IO = internus obliquus muscle)

125 - Impairment of Coordination During Bimanual Arm Swinging In Adults With Hemiparesis

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The coordination of bimanual movement is governed by a distributed network of brain areas. Perturbation of one arm during rhythmical bimanual movement disrupts intermanual coupling (phase relationships) and results in phase resetting in healthy subjects. However, such coupling may be impaired following stroke due to damage of specific brain structures as well as changes in the neuromuscular properties of the paretic arm. Our goal was to investigate the synchronization of both arms during bimanual swinging in the presence of external perturbation in patients with hemiparesis due to stroke. Nine healthy subjects and 12 patients with chronic hemiparesis participated. While standing, subjects swung their arms in a reciprocal manner (anti-phase) for 15s during which time, movement of one arm was unexpectedly and transiently (150 ms) arrested. The arrest occurred twice during the forward phase of swinging and twice during the backward phase at approximately ±10° with respect to mid-swing. Kinematic data were collected from 22 markers placed on the arms, trunk and legs (Vicon). The oscillatory period, relative phase within and between arms and the phase differences before, during and after perturbation were calculated. In healthy subjects, perturbation resulted in an increase in the cycle period in both the arrested and non-arrested arms in the cycle following the perturbation. In contrast, in participants with hemiparesis, perturbation resulted in a complete disruption of the intermanual coordination such that both arms moved with different frequencies after the perturbation. The period of the arrested arm became significantly shorter than that of the non-arrested arm. This resulted in independent movement of each arm and a transition from anti-phase to in-phase motion immediately after the perturbation that took more than 1 cycle to reverse back to the anti-phase pattern. Results show that the ability to rapidly regain bimanual coordination by "resetting" the movement of the non-arrested arm was disrupted in patients. This suggests that stroke-related brain damage results in a disruption in the central control of the timing of bimanual movement affecting both the affected and non-affected arms.