Deficits in higher-level adaptive systems include elderly people's lack to adapt to external perturbations. Using a model based approach, we aimed to identify which deficits dominate postural control of the elderly and which deficits are sensitive to balance training. METHODS: We analyzed postural control of 40 healthy elderly people with a mean age of 74 years. Half of them were randomly allocated into an intervention group and the other half were assigned to the control group. The intervention group received an intense ten week's balance training, whereas to the control group did not receive any intervention. Data of the intervention group was compared with data from 19 healthy young volunteers (mean age 28 years) and 16 healthy middle-aged volunteers (mean age 48 years). Postural control was characterized by spontaneous sway measures and measures of perturbed stance. We observed centre-of-pressure (COP) sway paths and angular and translational excursions of the body in space. Perturbations were induced in terms of a pseudorandom anterior-posterior tilt of the body support surface. Stimulus-response data were interpreted on the basis of a simple negative feedback model. RESULTS: As already known before, we found that spontaneous sway measures (RMS, MV and MeanFreq) were significantly higher in elderly than in young people. Gain, a measure based on the transfer function between external stimulus and body response, is highest in elderly and lowest in young people, being almost equally distributed across the frequencies tested. Balance training leads to a significant reduction of Gain in the intervention group. Based on model simulations, we found an increased reliance on proprioception, an increase in overall time delay, and a lower motor feedback in elderly subjects. CONCLUSIONS: Elderly people seem to rely more on proprioceptive than on vestibular or visual cues indicating that the vestibular system ages more or faster than the proprioceptive system. After balance training, there is a shift from proprioception to spatial orientation cues (vestibular and visual). In addition, we reproduced the common finding that time delay is increased in elderly people. We assume that the decrease of motor feedback may be caused by the loss of muscle mass in elderly people. We found significant correlations between clinical balance scores and the identified model parameters of postural control.

P3-Q-102 Sensory reweighting of proprioceptive input during balance control as function of age and disease

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Background and aim: Sensory (re)weighting is the automated and unconscious process of dynamically combining sensory inputs, e.g. proprioception, graviception and vision, during balance control. Typically, reliable sensory inputs are weighted more than unreliable and noisy sensory inputs, to prevent decline of balance control. Malfunctioning of sensory reweighting in case of sensory deterioration may be an important determinant of impaired balance in elderly with the consequence of physical impairment and falls. In this study, we used closed loop system identification techniques (CLSIT) to assess sensory weighting and reweighting of proprioceptive input of the ankle during upright stance as function of age and disease. Methods: Ten healthy young (age 25.4±2.2 years), ten healthy elderly (age 76.8±1.8 years), ten elderly with cataract (age 76.7±6.8 years) and ten elderly with polyneuropathy (age 73.7±8.0 years) were asked to maintain balance while the proprioceptive input of each ankle was disturbed by rotation of the support surface (SS) around the ankle axes. SS rotations were applied with specific frequency content and the perturbation amplitude increased over trials. Body sway and the total reactive ankle torque were recorded. The sensitivity functions of the ankle torque to the perturbation amplitude was determined using CLSIT. The gain of the sensitivity function (S) describes the ratio of the perturbation amplitude and the ankle torque as function of frequency and represents the proprioceptive weighting. Parameters describing the sensitivity functions were estimated using optimized model fits, of which one was the proprioceptive weight (Wp). Results: Healthy elderly were more sensitive to SS rotations as reflected by a significantly higher gain of S ($p<0.001$) compared with the young. In comparison with healthy elderly, elderly with a cataract had a significantly higher gain of S ($p=0.038$), unlike elderly with polyneuropathy ($p=0.37$). In all groups, the gain of S decreased significantly with increased disturbance amplitude ($p<0.001$). There was no interaction effect between perturbation amplitude and groups ($p=0.68$).The estimated Wp was significantly higher in healthy elderly compared with the young ($p=0.001$). Compared with healthy elderly, elderly with cataract had a significantly higher Wp ($p=0.003$), unlike elderly with polyneuropathy ($p=0.24$). In all groups, Wp decreased with increased perturbation amplitude ($p<0.001$). There was an interaction effect ($p=0.001$) between perturbation amplitude and groups. Conclusions: Using CLSIT, proprioceptive weighting and reweighting could be established as function of age and cataract; healthy elderly rely more on proprioceptive input compared with the young and elderly with cataract rely even more on proprioceptive input. Assessing the interplay between available sensory inputs is necessary to identify the weakest link in impaired balance as a primary therapeutic target.

P3-Q-103 Can young adults adjust their recovery step during unexpected tripping?

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BACKGROUND AND AIM: With an aging society and an increasing number of falls and fall-related injuries, fall prevention is of utmost importance [1, 2]. Tripping over obstacles is one of the main causes of falls [3]. When tripping over an obstacle, one needs to reduce the forward angular momentum that the body obtains from impact with the obstacle [1, 4]. This can be achieved by strong push-of forces of the support leg and a large recovery step, but this ability is often impaired in older adults. Although experiments have shown that tripping response adjustments occur when a trip is anticipated [5], it can be questioned whether people are able to control and adjust their recovery step during balance recovery. If so, this might provide possibilities for fall prevention training in older adults. We therefore aimed to investigate whether young adults are able to adjust their recovery foot landing position after an unexpected trip by avoiding a virtually presented forbidden landing zone (FZ). We hypothesized that young adults would be able to adjust their recovery steps, and that the rate of successful FZ avoidance would improve over trials. Moreover, we wanted to evaluate the characteristics of the adjusted steps and their consequences for balance recovery. METHODS: Sixteen healthy young adults (25±3 years) walked at their comfortable speed over a walkway equipped with 14 hidden obstacles. Subjects were tripped 10 times in between a random number of normal walking trials. Five of the trips included a presentation of a FZ at trip onset, positioned at the subject's preferred recovery foot landing position, hereby forcing subjects to adjust their response in order to avoid landing on the FZ. RESULTS: Subjects succeeded to avoid the FZ in 80% of trials, using either shortened steps (84%) or stepping to the side of the FZ (16%). Their performance improved over trials, and some subjects even switched strategies over