FEASIBILITY OF A PERTURBATION PROTOCOL TO QUANTIFY DYNAMIC STABILITY

INTRODUCTION

Falls in elderly are the leading cause of injury and therefore considered a major health problem in our ageing society [1]. A fall is the result of an inadequate restoration of balance when it is compromised. The use of external perturbations to evoke loss of balance in a standardized and safe manner is an increasingly popular approach to measure dynamic stability, offering opportunities for fall prevention research [2]. Although a perturbation-paradigm is promising, little is known about the type of perturbation that is most informative to quantify dynamic stability. Therefore, the first aim of this feasibility study was to evaluate whether mechanical, visual and auditory perturbations can be used to affect dynamic stability. The second aim was to evaluate whether we can distinguish between younger and older adults using the response to external perturbations.

CLINICAL SIGNIFICANCE

In order to reduce falls in the elderly population we have to identify those at risk for falls and provide targeted interventions in early stages. A perturbation-based dynamic stability assessment might be a sensitive way to assess fall risk.

METHODS

Nine healthy young (3 females; age 25.1±3.4y) and seven healthy older adults (7 females; age 72.3±7.2y) walked on the CAREN Extended (Motekforce Link BV, Amsterdam, The Netherlands) at comfortable speed while full-body kinematic data was collected (Vicon, Oxford, UK). A two minute baseline recording was followed by six types of perturbations: ipsi-lateral (SwyIpsi) and contra-lateral (SwyContra) platform sway, unilateral belt acceleration (Acc) and deceleration (Dec), sudden darkness (Viz) and an auditory startle (Aud) were imposed at the non-dominant heel strike. A 10-15 stride interval between perturbations introduced timing variability. Step length, step width, margins of stability (i.e. distance between the border of the base of support and the center of mass motion state [3]) in the lateral (Lt-Mos) and backward (Bw-Mos) direction were calculated for each step prior to the perturbation (T), the perturbation step (P) and four recovery steps (R1-R4). Repeated Measures-ANOVAs (6x steps; $P<0.05$) were used to compare perturbed walking to normal walking for each stability measure with group as between factor.

DEMONSTRATION

Swy-Ipsi, Swy-Contra and Dec perturbations significantly affected dynamic stability in terms of step length, step width, Lt-Mos and Bw-Mos. Acc perturbations significantly affected dynamic stability in terms of step length, step width and Lt-Mos. Viz and Aud perturbations

only affected Bw-Mos. Differences between younger and older adults were found for step length in response to the Acc and Viz perturbations.

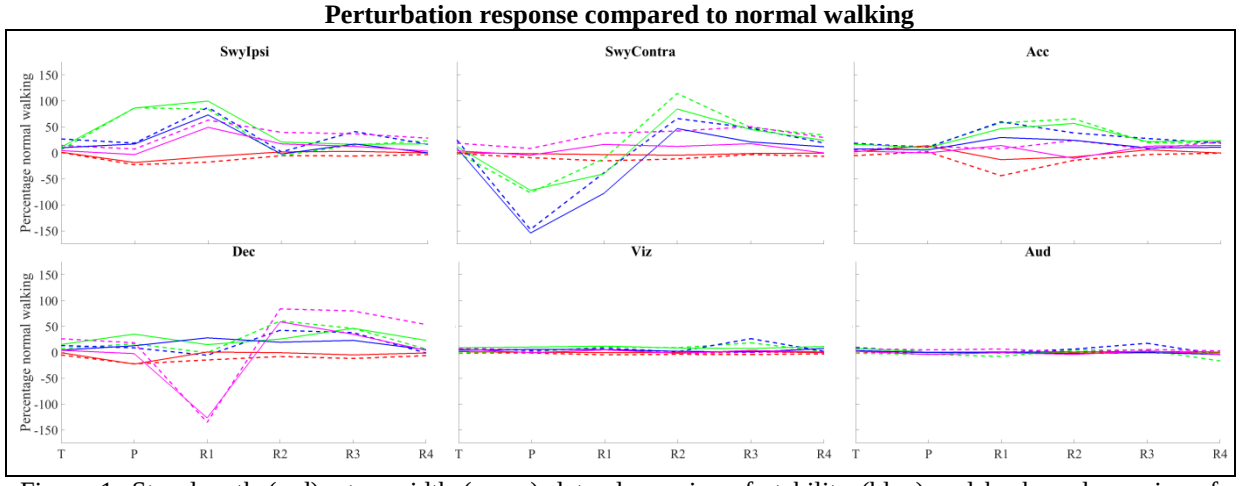

Figure 1: Step length (red), step width (green), lateral margins of stability (blue) and backward margins of stability (magenta) in response to perturbations (T: perturbation trigger; P: perturbation step; R1-R4: recovery steps) as a percentage of normal walking for younger (solid) and older (dashed) adults.

SUMMARY

All perturbation types affected dynamic stability in both younger and older adults. Although the ipsi- and contra-lateral sway and deceleration perturbations affected all dynamic stability measures (step length, step width, Lt-Mos and Bw-Mos), these types of perturbations did not show significant differences between younger and older adults. However, group differences were found for step length in response to the belt acceleration and sudden darkness perturbation. These results suggest that the use of external perturbations to quantify dynamic stability is informative as long as the perturbation type and stability measure are chosen carefully. Our next step is to evaluate the perturbation protocol in older adults with a history of falls.

REFERENCES

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