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Heel acceleration at heel strike and slip outcome

K. Beschorner and R. Cham

Bioengineering, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: The dynamics of the leading leg, especially heel displacement and velocity, have been the focus of several studies yet few researchers have considered heel acceleration. One study has described heel acceleration during slipping [1], while another study described heel acceleration during swing phase prior to slip initiation [3]. Anterior/posterior heel acceleration may be of interest because it represents the combined effects of leading leg kinetics, which may hold the leading leg reducing the severity of the slip [2]. Heel strike time represents an initial condition to the slip and therefore may be used to identify risk of falling in subjects.
Methods: Sixteen young (aged 20-33) and eleven older (aged 55-67) subjects were consented to participate in the study and donned a safety harness during all trials. A total of 79 markers were placed on the subjects and tracked during the trials to characterize their motion. Subjects walked across a tiled floor surface instrumented with forceplates. Subjects experienced four walking trials: the floor was dry during the first three trials and then a slippery liquid was applied to the floor without their knowledge for the fourth trial. Anterior/posterior heel acceleration of the leading leg was determined at heel strike. Ankle, knee and hip torques of the leading leg were calculated using a bottom up inverse dynamics approach from ground reaction forces measured at the floor. Joint torques were parameterized at heel strike. Slip trials were classified as falls if the hip centers fell 5% below the local minimum of the dry trial.
Results: Recovery subjects were found to have higher posterior heel acceleration at heel strike than fall subjects ($p<0.05$). Posterior heel acceleration at heel strike was found to correlate with ankle dorsiflexion torque ($r=0.61$, $p<0.001$), knee flexion torque ($r=0.84$, $p<0.001$) and hip extension torque ($r=0.68$, $p<0.001$). Therefore subjects who recovered have larger posterior heel accelerations, which seem to be the result of leading leg torques.
Conclusions: The larger posterior heel accelerations at heel strike seem to be a result of leading leg kinetics, particularly the knee torque. Having larger joint torques to pull back the heel at heel strike and early in stance may be beneficial towards slip recovery. Therefore increasing posterior heel acceleration by increasing activity in knee flexors may be beneficial to reducing falls. REFERENCES: 1. Cham, R., Redfern, M.S., 2002. Safety Science 40, 559-576. 2. Cham, R., Redfern, M.S., 2002. Gait & Posture 15, 159-171. 3. Lockhart, T.E., Kim, S., 2006. Gait & Posture 24, 23-34.

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Effects of age and loss of balance direction on the threshold of balance recovery

A. Telonio[1] and C. Smeesters[1]

[1]Research Center on Aging, Sherbrooke, QC, Canada, [2]Human Performance and Safety Laboratory (PERSEUS), Université de Sherbrooke, Sherbrooke, QC, Canada and [3]Department of Mechanical Engineering, Université de Sherbrooke, Sherbrooke, QC, Canada

Introduction: The effects of age and loss of balance direction on the threshold of balance recovery have not been quantified, despite evidence of their importance during small and medium postural perturbations. Moreover, understanding the effects of age and loss of balance direction are particularly important given that case controlled studies have shown that sideways falls, compared to other fall directions, increase hip fracture risk. Therefore, the purpose of this study is to quantify the effects of age and loss of balance direction on the threshold of balance recovery.
Methods: Balance recovery following sudden release from an initial lean was performed by six healthy younger adults (22.5±4.0yrs) and six healthy older adults (65.2±0.9yrs) with an equal number of males and females in each group. The maximum lean angle that these healthy adults could be released from and still recover balance using a single step was determined for i) forward, ii) dominant side, iii) non-dominant side and iv) backward leans. Lean angles, reaction times, weight transfer times, step times, step lengths and step velocities were measured using force platforms and a motion measurement system. Two-way analyses of variance with repeated measures were used to determine the effects of age and lean direction.
Results: Both age ($p=0.001$) and lean direction ($p<0.001$) significantly affected the maximum lean angles that healthy adults could be released from and still recover balance using a single step. There was also a significant interaction between age and lean direction ($p=0.027$). Moreover, at the maximum lean angles, age and lean direction also affected several of the kinematic variables.
Conclusions: Results have shown that lean direction significantly affects the postural disturbance younger and older adults could sustain. Moreover, the age-related reduction in maximum lean angles is more important for dominant (46%) and non-dominant (41%) leans than for forward (36%) or backward (27%) leans. It is thus conceivable that different mechanisms could be responsible for balance recovery in different directions. Further experiments are needed to confirm these results in a larger sample of younger and older adults.

Effect of lean direction on kinematic variables for younger (YA) and older (OA) adults

Lean Direction	Age	Maximum lean angle (deg)	Reaction time (s)	Weight transfer time (s)	Step time (s)	Step length (m)	Mean step velocity (m/s)	Maximum step velocity (m/s)
Forward	OA	20.1±2.6	0.070±0.007	1.284±0.023	0.216±0.030	0.794±0.043	3.74±0.65	5.17±0.69
	YA	31.3±4.3	0.067±0.013	1.247±0.029	0.190±0.015	0.957±0.089	5.10±0.82	7.32±1.47
Dominant	OA	13.5±6.3	0.085±0.012	1.344±0.076	0.242±0.108	0.529±0.128	2.48±1.06	3.53±1.23
	YA	25.1±3.7	0.080±0.008	1.237±0.037	0.192±0.042	0.702±0.055	3.78±0.77	5.08±0.86
Non-Dominant	OA	14.4±4.6	0.083±0.007	1.292±0.072	0.243±0.092	0.590±0.119	2.59±0.70	3.53±0.70
	YA	24.3±2.3	0.075±0.004	1.262±0.026	0.204±0.032	0.729±0.094	3.63±0.59	4.46±0.51
Backward	OA	14.9±3.6	0.095±0.018	1.235±0.114	0.258±0.031	0.615±0.149	2.44±0.75	3.85±0.93
	YA	20.3±3.1	0.086±0.007	1.179±0.025	0.229±0.034	0.789±0.165	3.44±0.50	5.04±0.97

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Fear of falling, its psychological components and slip-warning induced gait adaptations in older adults with mild mobility impairments

B. Coley[1], E.J. Lenze[2], S. Perera[3], J. VanSwearingen[4], S. Studenski[3] and R. Cham[1]

[1]Bioengineering, University of Pittsburgh, Pittsburgh, PA, USA, [2]Psychiatry, University of Pittsburgh, Pittsburgh, PA, USA, [3]Geriatric Medicine, University of Pittsburgh, Pittsburgh, PA, USA and [4]Physical Therapy, University of Pittsburgh, Pittsburgh, PA, USA

Introduction: Fear of falling (FOF) is a major public health concern in the elderly [1]. Most gait research in FOF has been con-

Key to Abstracts

KS = Keynote Session
FS = Featured Symposia
Concurrent Oral and Poster Sessions
First character denotes day of presentation
- S = Sunday, July 15
- M = Monday, July 16
- T = Tuesday, July 17
- W = Wednesday, July 18

Second character denotes session
- O = Oral
- P = Poster

Number denotes order of presentation (for oral) or board number (for poster)