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Age-related slip avoidance strategy while walking over a known slippery floor surface

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Abstract

When confronted with impending slip/fall situations, gait parameters are adjusted accordingly to avoid slipping. This study was conducted to assess age-related slip avoidance strategy by measuring gait parameters and muscle activity characteristics of the lower extremities (hamstrings, calves, and quadriceps) of both young and older participants while ambulating successfully over a known slippery floor surface. Fourteen younger and 14 older adults participated in this study. First, a baseline measure was collected to study normal gait prior to any exposure to slipping. A second measure was collected following a slip from a contaminated floor surface, but before the initiation of a second slip, where the participants were able to view the contaminated surface before traversing it. The results indicated that there were significant gait parameter differences between normal-dry walking conditions and contaminated-slippery walking conditions. In general, participants (young and old) reduced step length, friction utilization, and heel contact velocity from normal gait to adjusted gait conditions. Furthermore, results also indicated that there were differences in gait parameters and muscle activity characteristics between the two age groups for both a normal gait condition and a gait condition requiring adjustment. Findings suggested that older individuals required an additional step to properly adjust gait for a contaminated walking surface.

Keywords

Gait; Age; Slips; Falls; Electromyography

1. Introduction

Reducing slip and fall accidents among older individuals has been a goal for many researchers for several decades. Numerous studies have shown that with advancing age, there is an increasing incidence of falling [1–4]. In the age 65 and over population, for example, 35–40% of community dwelling, generally healthy elderly persons fall annually [28,29]. In those aged 75–80 years, falling becomes more prevalent as 35–50% will fall every year [28]. When a fall does occur, older individuals are much more likely to suffer from injury. In fact, falls are the leading cause of injury-related deaths among people 65 years and older [30,31]. In 1998, approximately 10,000 people over the age of 65 year died from fall-related injuries [30]. Specifically, 75% of deaths due to falls in the United States occur in 13% of the population aged 65 and over [4]. Physical injury is only part of the problem. Falls have also become an expensive cost to society. Fall-related injuries account for 6% of all medical expenditures for persons aged 65 year and older in the United States [32]. The total cost of all fall injuries for

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people aged 65 or older in 1994 was US$ 20.2 billion. By 2020, the cost of fall injuries is expected to reach US$ 32.4 billion [32]. Furthermore, the elderly population is also increasing. Currently, there are approximately 35 million elderly individuals in the United States; this number is projected to double to more than 70 million by the year 2030 [5]. One could infer that the problem with slips and falls for older adults will become more severe, since the population of people over 65 years of age is increasing.

Although epidemiological findings clearly indicate increasing rate of fall accidents among the elderly, comprehensive understanding of age-related mechanisms associated with fall accidents is lacking. Specifically, age-related slip avoidance strategy has not been investigated. The primary goal of this study was to assess age-related slip avoidance strategy by measuring gait parameters and muscle activity characteristics of the lower extremities (hamstrings, calves, and quadriceps) of both young and older participants during the heel contact phase of the gait cycle while ambulating successfully over a known slippery floor surface. This type of situation is frequently encountered, for example, during walking over a freshly mopped surface at a grocery store. Understanding age-related differences in gait parameters and muscle activity characteristics during this period of adjustment, for both age groups, may add to previous knowledge and ultimately help in proactively reducing slip and fall accidents among the elderly.

When confronted with impending slip/fall situations, gait parameters are adjusted to maintain optimal friction demand of the foot/floor interface to avoid slipping [23]. Reduction of friction demand, step length, and heel velocity all occur as a result of gait adjustment [17,18,23]. However, age-related gait adaptations and muscle activity patterns may hinder these gait adjustments. Gait adaptation frequently occurs as a result of aging. Elderly people often walk with shorter step length with a wider base of support, and slower transitional acceleration of the whole body center-of-mass (COM) [13,24]. Additionally, higher heel contact velocities have been reported for the frail elderly population at the time of the heel contact phase of the gait cycle [13]. These gait adaptations further increase risk of slipping, for example, higher heel contact velocity can increase horizontal ground reaction force in relation to vertical ground reaction force and as a result, friction demand can increase [25]. Furthermore, slower transitory acceleration of the whole body COM among the elderly can also increase friction demand at the shoe/floor interface and increase risk of slipping [24]. In case of eliciting gait adjustments (during slip avoidance), elderly individuals' gait adaptation may encumber optimal gait adjustment strategy.

Furthermore, older adults' lower extremity muscle activity characteristics during gait adjustment period may be important for assessment of slip avoidance strategy. Older adults exhibit reduction in fast twitch muscle fibers in comparison to slow twitch muscle fibers [26, 27]. The age-related changes in the skeletal muscle property, such as muscle fiber types may hinder quick gait adjustments required for successful ambulation over slippery floor surfaces.

In this study, age-related gait characteristics while ambulating over a known slippery floor surface were investigated. Additionally, age-related lower extremity muscle activity characteristics associated with these gait adaptation were investigated. We hypothesized that older adults' gait characteristics would be different than their younger counterparts while ambulating over a known slippery floor surface due to their gait adaptations and associated muscle activity characteristics of the lower extremities.

2. Methods

2.1. Participants

Fourteen older individuals (65 years and older) and 14 younger individuals (18–35 years of age) participated in the experiment (Table 1). Both groups consisted of seven females and seven males. The young adults were recruited from general student population at Virginia Tech and older adults were recruited from the local community. Participants' anthropometric characteristics were matched so that participants between the 5th and 95th percentiles of height and weight were represented. The older participants were required to have successfully completed a medical examination within the past 6 months, be in good physical and mental heath (dementia), and have no restrictions to physical activity. Furthermore, the younger individuals were in good physical and mental heath, and had no physical restrictions to activity. Each participant completed an inform consent form approved by the Virginia Tech Internal Review Board (IRB).

2.2. Apparatus

A linear walking track (Fig. 1) was used to conduct the walking trials. An overhead track supporting a fall-arresting support system, with a safety harness, was utilized to protect individuals from fall-related injury. Vinyl flooring materials (Armstrong) were used in this experiment to simulate a realistic environment. Soapy water (a mixture of two parts soap and three parts water) was applied to the vinyl floor as a contaminant. The measured dynamic coefficient of friction (DCOF) of the contaminated floor was 0.08. The area of contaminated flooring was located on a sliding track and operated by the experimenter to alternate contaminated and non-contaminated surfaces without the participant's knowledge. Two workstations were placed at each end of the track to direct the attention of the participant away from the floor surface. The function of this system was to control the experiment such that the floor surface could be changed from not slippery to slippery without the participants' awareness.

Lower extremity muscle activity (as measured through the gastrocnemius lateralis (calf), semitedinosis (hamstring), and rectus femoris (quadriceps)) was measured using surface electromyography (EMG). EMG signals were sampled and measured by a wireless, eight-channel EMG system (Noraxon) at a sampling rate of 1200 Hz.

A built-in amplifier bandpass-filtered the signal (10–500 Hz) and performed an RMS conversion (50 ms time constant). Raw EMG signals were monitored, sampled, and stored by the National Instrument hardware and the LabView system.

An infrared passive marker system (ProReflex Qualysis) utilizing six cameras was used to collect three dimensional posture data (sampled and recorded at a rate of 120 Hz) of the participants. All together, 26 reflective-markers were attached to anatomically significant landmarks [24] to represent the whole body, and two markers were attached to the heel to measure gait parameters. Two Bertec force plates at a sampling rate of 1200 Hz measured ground reaction forces exerted by the participants as they walked over the test surface.

2.3. Experimental procedure/design

Two measurement conditions were studied. First, a baseline measure was collected to study normal gait prior to any exposure to slipping. Second, a measurewas performed following a slip from a contaminated floor surface, but before the initiation of a second slip. Here participants were allowed to view the slippery floor surface before walking over it again while trying not to slip. This gait condition was referred to as the adjusted condition. The adjusted condition region was defined as the transitional step from the dry force plate to the contaminated force plate. Heel contact velocity (HCV) and required coefficient of friction (RCOF) were calculated for the heel contact dynamics of the adjusted step onto the contaminated surface (later referred to as adjustment 2—illustrated in Fig. 1), as well as the step prior to stepping on the contaminated surface (later referred to as adjustment 1—illustrated in Fig. 1). There were two adjustments noted in the adjusted gait condition. Adjustment 1 was a preliminary adjustment step prior to stepping on the contaminated surface on force plate 1 (F1). This was measured in order to characterize age group differences in the step before the adjustment step onto the slippery surface. Adjustment 2 refers to the step onto the slippery force plate 2 (F2). In order to assess the characteristics of gait adaptation (not motor learning), participants performed only one adjusted trial.

Muscle activity is characterized by activity duration (during the step cycle of one heel contact to the other) from one force plate to the other. As such, step cycle was normalized to 100% from heel contact to toe-off of the same foot. The amplitude of EMG curves was not normalized to provide actual EMG activities (mV). Furthermore, the peak and mean of this activity were measured for the duration of gait cycle (Fig. 2). The onset of the muscle activity occurred between the two points (i.e., heel contact to toe-off). During the period, the onset of EMG activity was defined as the point where the signal first deviated more than 2 S.D. from the level recorded as the baseline [33]. The cessation of EMG activity was determined by the same value [34].

Gait parameters measured included horizontal heel contact velocity, required coefficient of friction, and step length. For the normal gait condition, gait parameters were measured from the transitional step from one force plate to the other (Fig. 3). For the adjusted gait condition, heel contact velocity and friction requirement were measured for both the preliminary adjustment (adjustment 1) and the transition step adjustment (adjustment 2) onto the slippery surface. Participants were instructed to walk at their preferred walking speed to assess natural gait characteristics during normal and adjustment conditions.

Heel contact velocity (HCV) was calculated by using the formula, $|(X_{i+1} - X_{i-1})/2\Delta t|$ cm/s (where t = time, and X = horizontal displacement component). This was calculated for 10 frames (0.083 ms) proceeding and 1 frame following heel contact. The heel velocity results for the 11 frames were averaged to obtain an average heel contact velocity. Heel contact velocity was calculated for each force plate for both walking conditions.

Step length is the length (in centimeters) from heel contact to heel contact of one foot to the other (the heel position during the final heel contact on the first force plate to the initial heel contact on the second force plate). This was measured for each participant through the motion capture system utilizing the distance formula ($\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}$) where (X_1, Y_1) represents the position of the first foot and (X_2, Y_2) is the position of the alternating foot in transversal plane. This was done by measuring the heel position during the final heel contact on the first force plate to the initial heel contact on the second force plate.

Friction requirement (the ratio of horizontal to vertical force (F_H/F_V) at peak 3) was measured for each participant through information gained by the force platforms for both normal and adjusted (contaminant) walking conditions.

Dependent measures of gait parameters (friction demand, heel contact velocity, and step length) were analyzed using a 2 × 2 repeated measures (age × condition) analysis of variance (ANOVA) design. Tukey–Kramer post hoc analysis was performed on measures with more than 2 repetitions for significance. Furthermore, bivariate regression analysis was performed to describe possible relationships among dependant variables.

3. Results

3.1. Gait parameters

Age-related changes to gait parameters may exist, suggesting that older individuals may be more susceptible to slip induced falls. Results indicate several significant differences in gait parameters found between younger and older participants. Overall, older participants had a lower required coefficient of friction (RCOF) than younger individuals ($F_{1,26} = 12.3356$, $P = 0.0016$), exerted a lower heel contact velocity than younger individuals ($F_{1,26} = 10.6733$, $P = 0.0030$), and had a shorter step length (in centimeters) than younger participants ($F_{1,26} = 4.7245$, $P = 0.0390$). Gait parameters are represented in Table 2 and Figs. 4–6.

Bivariate regression analysis indicated that as RCOF for the normal gait condition increased, HCV on the second force plate increased ($F_{1,26} = 4.5937$, $P = 0.0416$) where $r = 0.150$ (linear correlation coefficient). Additionally, as RCOF values for a normal gait condition increased, total slip distance increased ($F_{1,26} = 10.2004$, $P = 0.0037$) where $r = 0.282$. Overall, a higher required coefficient of friction (ROCF) was found for a normal walking condition versus both adjustment conditions ($F_{2,25} = 125.2063$, $P < 0.0001$).

Younger participants' RCOF (Fig. 4) was statistically significantly higher than older participants for a normal gait condition ($F_{1,26} = 11.2843$, $P = 0.0024$). A higher RCOF value was found for adjustment 1 than for adjustment 2. Younger participants RCOF was statistically significantly higher than older participants for the preliminary adjusted gait condition (dry surface: $F_{1,26} = 9.2350$, $P = 0.0054$). No statistically significant difference was found for the age effect of RCOF on the slippery condition ($F_{1,26} = 0.9230$, $P = 0.3455$).

Younger participants HCV (Fig. 5) was significantly higher than older participants for the normal gait condition ($F_{1,26} = 7.6377$, $P = 0.0104$). Younger participants HCV was significantly higher than older participants for the preliminary adjusted gait condition (dry force plate: $F_{1,26} = 12.7816$, $P = 0.0014$). However, there was no statistically significant difference for age in the slippery condition ($F_{1,26} = 1.7738$, $P = 0.1945$).

Step length (Fig. 6) was shorter for the adjustment condition than for the normal condition for all participants ($F_{1,26} = 36.7522$, $P < 0.0001$). Although younger participants had a longer step length than older participants for both conditions, and both age groups had a shorter step length for the adjusted condition, there was not a significant age by condition effect.

Older participants required a lower coefficient of friction for adjustment 1 (the step prior to stepping upon the contaminated force plate) than younger individuals; whereas both age groups required a similar coefficient of friction for adjustment 2 (the step upon the contaminated force plate $F_{2,25} = 3.1727$, $P = 0.0501$). Younger individuals' HCV was higher than older individuals for heel contact prior to stepping upon the contaminated force plate for an adjusted gait condition ($F_{1,26} = 12.7816$, $P = 0.0014$). However, there was no statistically significant difference for age for the adjustment 2 condition on the contaminated force plate ($F_{1,26} = 1.7738$, $P = 0.1945$).

3.2. Muscle activity

Differences in muscle activity were also found for all participants between both the normal and adjusted gait conditions. In general, participants had a longer stance leg hamstrings (HAM) activity duration in seconds for an adjusted gait condition than for a normal gait condition ($F_{1,26} = 7.6075$, $P = 0.0105$). Overall, all participants had a lower stance leg rectus femoris (RF) mean activity for an adjusted gait condition than for a normal gait condition ($F_{1,26} = 5.0324$, $P = 0.0336$). Participants also had a lower swing leg gastrocnemius (GAS) peak activity ($F_{1,26} = 4.9986$, $P = 0.0342$) and mean activity ($F_{1,26} = 9.6012$, $P = 0.0046$) for an adjusted gait condition than for a normal gait condition. Additionally, all participants' swing leg HAM activity duration increased from a normal gait condition to an adjusted gait condition ($F_{1,26}$ = 9.0823, P = 0.0057). In general, all participants' swing leg RF mean activity decreased from a normal gait condition to an adjusted gait condition ($F_{1,26}$ = 7.6516, P = 0.0103).

Relationships between muscle activity and gait kinematics were also found during an adjusted gait condition for all participants. As stance leg GAS peak activity for an adjusted gait condition increased, RCOF on a contaminated surface for the adjusted gait condition increased ($F_{1,26}$ = 4.7497, P = 0.0386) where r = 0.390. As stance leg HAM activity duration for an adjusted gait condition increased, RCOF on a contaminated surface for the adjusted gait condition decreased ($F_{1,26}$ = 4.0335, P = 0.0551) where r = −0.134. As step length for an adjusted gait condition increased, stance RF activity duration (($F_{1,26}$ = 11.0778, P = 0.0026) where r = 0.299), swing RF peak activity (($F_{1,26}$ = 5.2151, P = 0.0308) where r = 0.167) and mean activity (($F_{1,26}$ = 4.6114, P = 0.0413) where r = 0.151) for an adjusted condition increased.

There were also differences in muscle activity between the two age groups. These differences existed in the quadriceps muscle group (RF) on the stance leg (Table 3 and Figs. 7 and 8). Younger participants' stance leg RF activity duration increased from a normal gait condition to an adjusted gait condition; whereas older participants' stance leg RF activity duration decreased from a normal gait condition to an adjusted gait condition ($F_{1,26}$ = 10.4162, P = 0.0034). Moreover, there was a statistically significant difference found for the condition by age effect on the stance RF mean value in mV ($F_{1,26}$ = 5.1165, P = 0.0323). Younger participants' RF mean activity decreased from a normal gait condition to an adjusted gait condition; whereas older participants' RF mean activity remained approximately the same for both conditions.

4. Discussion

To help avoid slip-induced falls, gait parameters are adjusted to correct for contaminated or slippery conditions. Persons who have a prior knowledge of a contaminated walkway adjust gait parameters by reducing RCOF, heel velocity and step length [17–20]. Cham and Redfern [17] suggested that individuals reduce step length, RCOF, and heel velocity to reduce likelihood of slipping. For a known slippery walking condition, young individuals adapted their gait within one step prior to stepping into the slippery floor surface [20]. Data from the present study supported findings from previous studies by showing significant differences for study participants transitioning from a normal floor surface (dry) to a floor surface requiring adjustment (slippery). Significant differences were found for step length, friction requirement (RCOF), and heel contact velocity for all participants.

A primary goal of the present study was to examine age-related differences to gait modifications during ambulation over a known slippery floor surface. The present study found significant differences (between younger and older participants) in gait parameter measures and muscle activity for adjusted gait versus normal gait conditions. Factors including heel velocity, RCOF, and step length are more critical when taking into account walking situations that may be more susceptible to slip-induced falls [12,21–23].

These findings reinforce previous research by showing that both groups reduced step length, friction utilization, and heel contact velocity from normal gait to adjusted gait (the transitional step from a normal surface to a contaminated surface).

Participants were able to reduce friction demand on the known slippery floor surface by adjusting both the stance leg and the swing leg. For the stance leg and swing leg, longer hamstring activation duration was required to reduce step length, heel contact velocity and friction demand. During the step cycle, the calf muscle extensor group is mainly active during the toe-off phase and the quadriceps muscle extensor group is active following the toe-off phase to lift the leg, giving the foot sufficient ground clearance; following this, the extensor muscle group of the hamstring is active during the heel contact phase of the gait cycle [6]. This suggests that an adjustment in gait was evident albeit the adjustment step onto the slippery surface was similar for both age groups. This may suggest that younger and older persons exhibited similar adjustment characteristics when stepping from a dry surface to a contaminated one.

A very interesting finding for the adjustment condition lies not on the contaminated force plate as hypothesized, but on the dry force plate preceding it. These findings add to previous research by showing that for the preliminary adjustment step (prior to stepping on the contaminated surface), heel contact velocity and friction utilization were considerably lower for older participants than for younger participants. This suggests that older participants were utilizing an extra step to adjust gait before walking on to the slippery surface. The older participants reduced both heel contact velocity (HCV) and required coefficient of friction (RCOF) well before traversing the contaminated surface than did younger participants.

Furthermore, as there was no age by condition interaction for normal versus adjusted step length, it may suggest that older individuals were adjusting gait parameters one step before younger participants, only to achieve similar adjustment results onto the slippery floor surface.

Muscle activity characteristics dupring adjusted gait were also different between the two age groups. It is likely that younger participants were able adapt their gait to the slippery floor surface within one step by decreasing the quadriceps mean muscle activity; whereas, older participants' RF mean activity remained approximately the same for both the adjusted step and the proceeding step. Thus, an age group difference in adjustment strategy is evident in adjustment prior to stepping on the contaminated floor surface for older participants. However, differences involving strategy may suggest that differences exist in cognitive processes or decision-making. While this remains uncertain and a possible avenue for future research, it is evident that there are differences in muscle activity that may be due to a variety of circumstances including, but not limited to, age or the age group difference involving the preliminary adjustment. It was evident that older participants required an extra step in order to effectively adjust gait parameters for the slippery floor condition. Therefore, results from this study may suggest that although both participant groups had prior knowledge of the contaminated surface, it was necessary for the older participants to make gait modifications one step before traversing the contaminated surface to avoid slipping.

Age group differences in muscle activity were located in the quadriceps muscle on the stance leg. Younger individuals increased activity duration and decreased mean activity from normal gait to adjusted gait, whereas older individuals decreased activity duration from normal gait to adjusted gait with mean activity remaining roughly the same. Again, this may suggest that older and younger participants had different adjustment strategies. Nonetheless, this does suggest that older and younger participants exhibited differences in gait adjustment even though the underlying cause of this difference is still inconclusive. Future study investigating the effect of age-related fear of falling/anticipation is further needed to clarify the differences in gait adjustment strategy for the elderly.

These findings reinforce previous research by showing both groups reduced friction utilization and heel contact velocity from normal gait to adjusted gait, but that older individuals reduced both of these parameters well before the younger individuals during this adjustment condition. An age group difference in adjustment characteristics is evident in the preliminary adjustment prior to stepping on the contaminated floor surface for the older participant group. It was evident that older participants required an extra step in order to adjust gait parameters for the slippery floor condition. This preliminary adjustment may help support the age group difference in muscle activity for the gait adjustment on the contaminated surface.

Future research is still needed to expand upon the present study and may attempt to explain these differences. This may ultimately be very important regarding application of risk assessment, warning information, and how older individuals perceive a potentially hazardous situation. From an engineering perspective, environment design issues, such as flooring or lighting, could be an important factor in the reduction of these potential hazards. Findings from the present experiment, suggesting that older persons may have a different adjustment strategy than younger persons, are only true for the subject population studied.

Recommendations made in the present study are kept general due to possible limitations of the present study. Future research may expand upon findings from the present study and advance scholars and practitioners understanding of gait adjustment strategies. As the older adult population increases, advancement in information regarding the mechanisms associated with proactively avoiding slips and falls, by adjusting gait characteristics, may lead to a decrease in fall-related accidents. Future research is needed to expand upon the present study and attempt to find out why these differences in gait adjustment may be occurring.

In conclusion, the young as well as the elderly modified their gait to safely traverse over a known slippery surface. However, older participants required additional step to adapt for the contaminated floor surface, as compared with their younger counterparts. This suggests that more cautious adjustment strategy may be involved among older individuals. Older individuals may simply need more time to adjust their gait. Thus, the potential hazard has to be identified earlier for the elderly. We assert that it is important to consider this information when designing warning displays on slippery surfaces.

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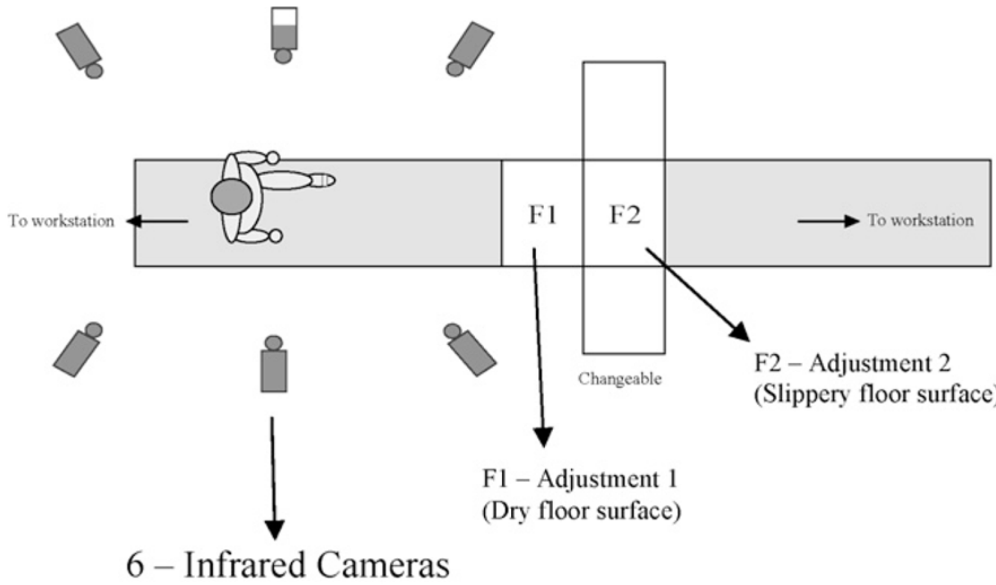

Fig. 1.

Walking track with fall arresting harness. The flooring in the middle is interchangeable from slippery to non-slippery floor surface. The 6 infrared cameras are for use with the Qtrac motion capture. F1, adjustment 1 is associated with gait adjustment (one leg) on force plate 1 prior to stepping onto a known slippery floor surface located at F2 (force plate 2 location). F2, adjustment 2 is associated with gait adjustment (another leg) on the slippery floor surface on force plate 2.

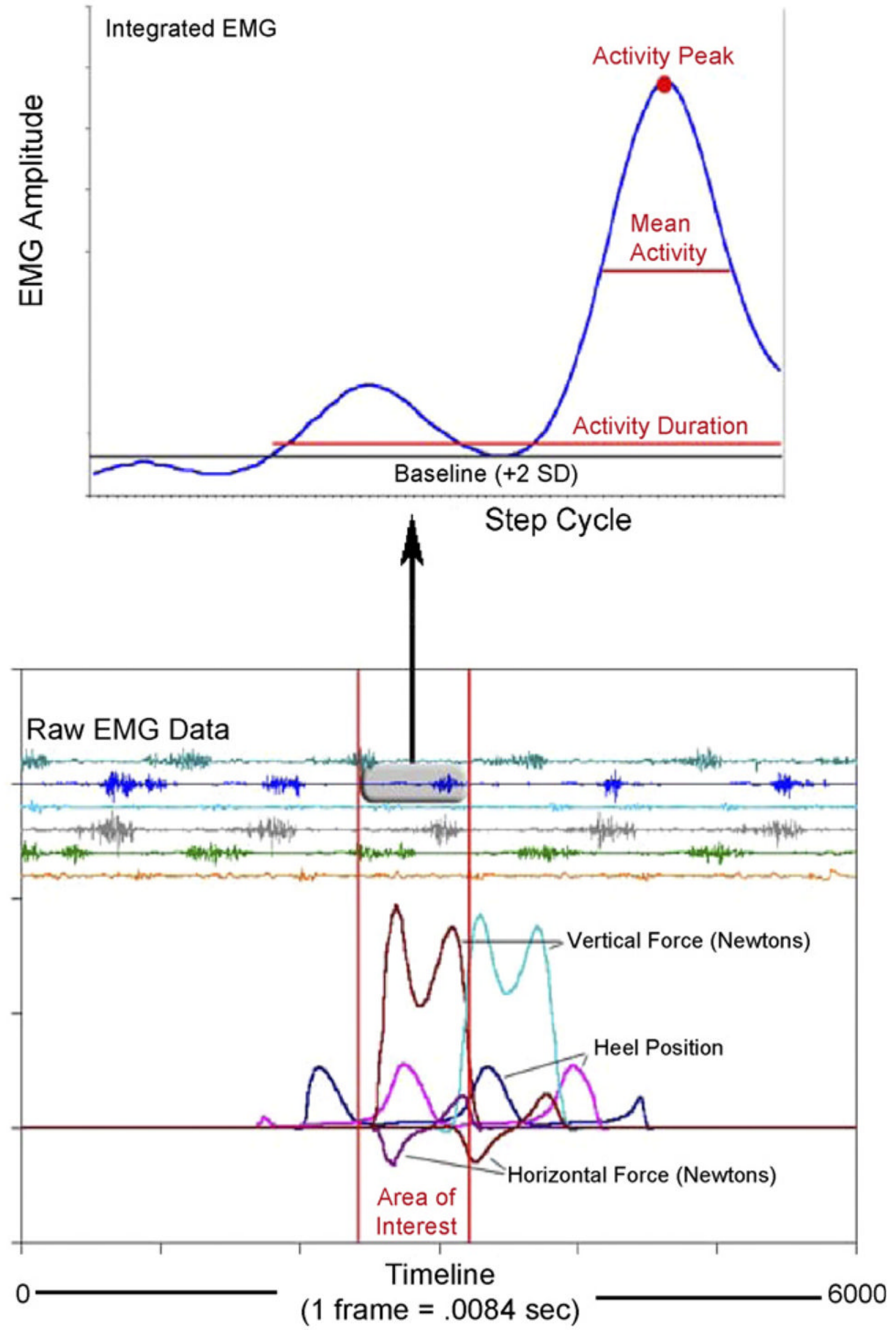

Fig. 2.
Example of bounded region of interest (heel contact to heel contact) and muscle activity measurements using right hamstrings as an example.

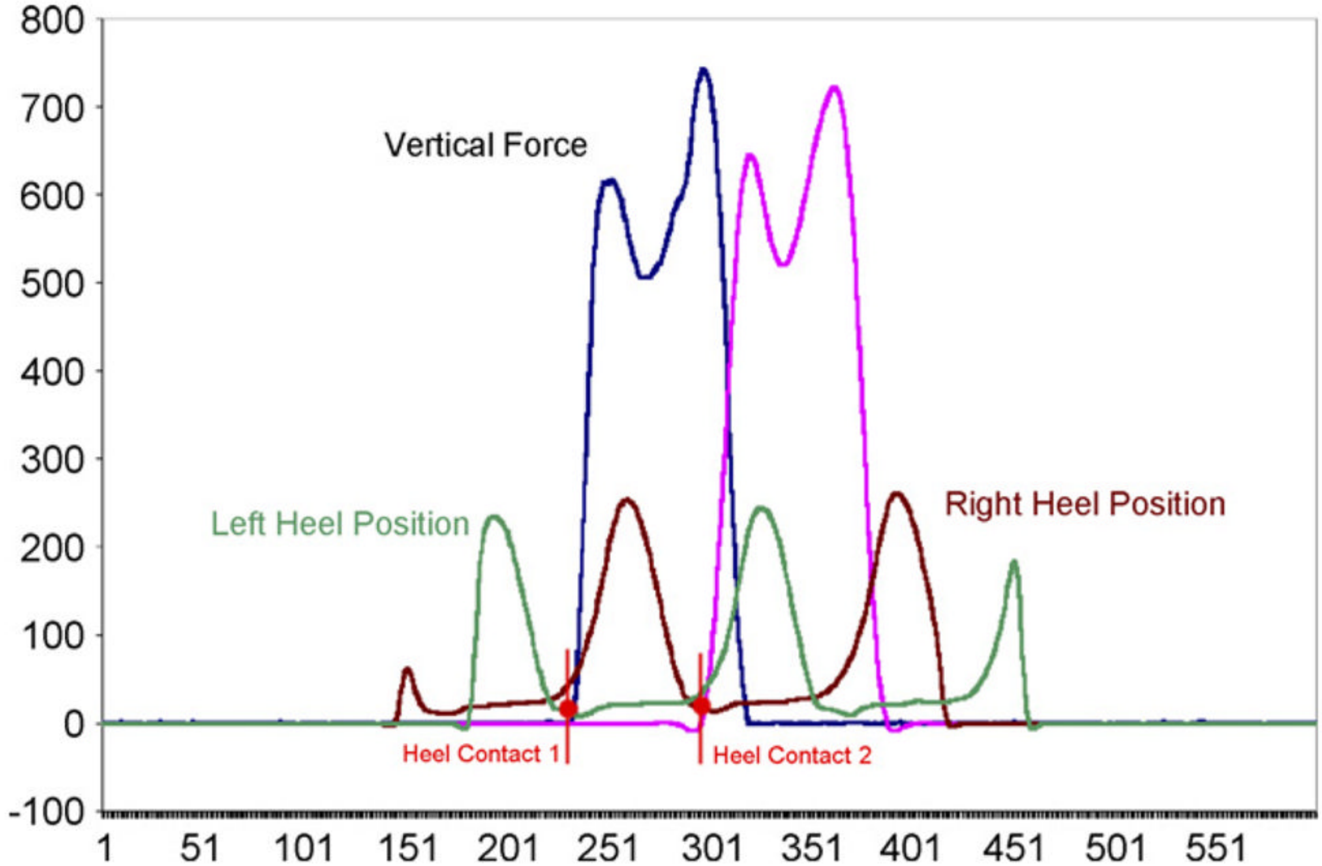

Fig. 3.
Illustration of gait parameter measurement area.

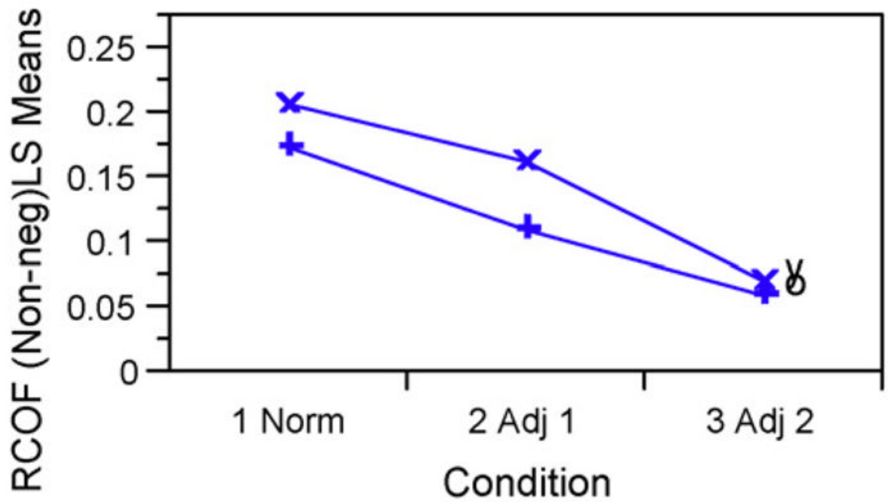

Fig. 4.
Age by condition: RCOF.

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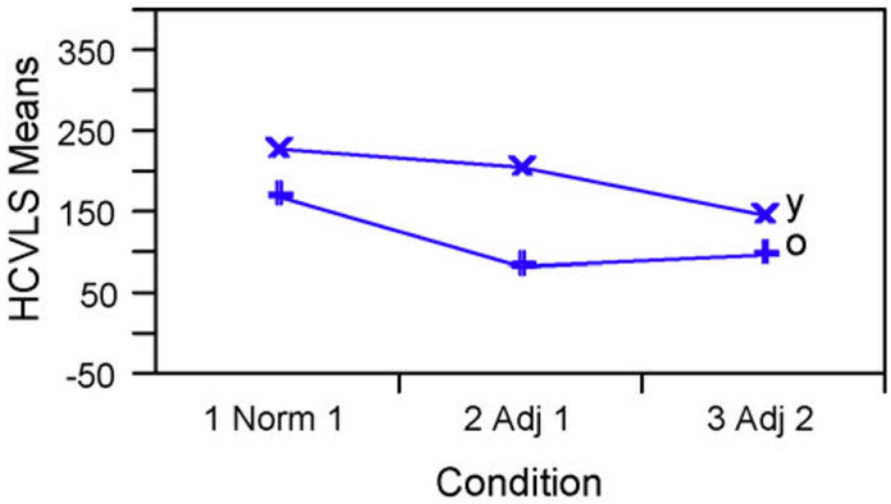

Fig. 5.
Age by condition: HCV.

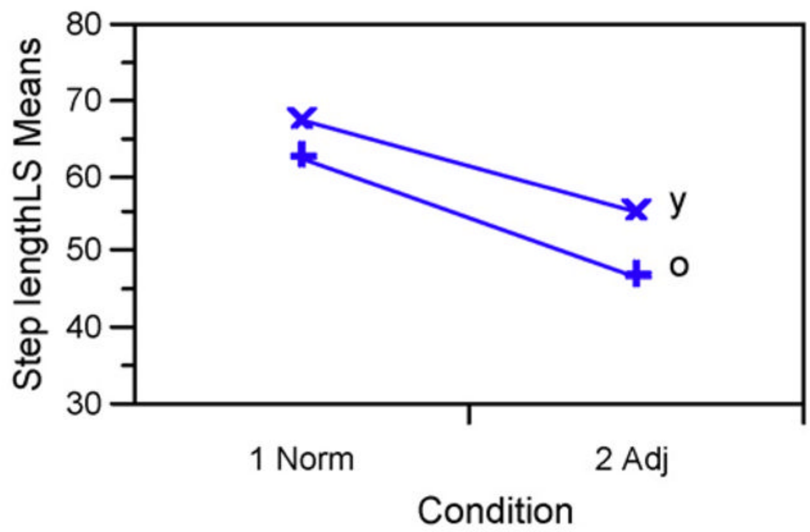

Fig. 6.
Age by condition: step length.

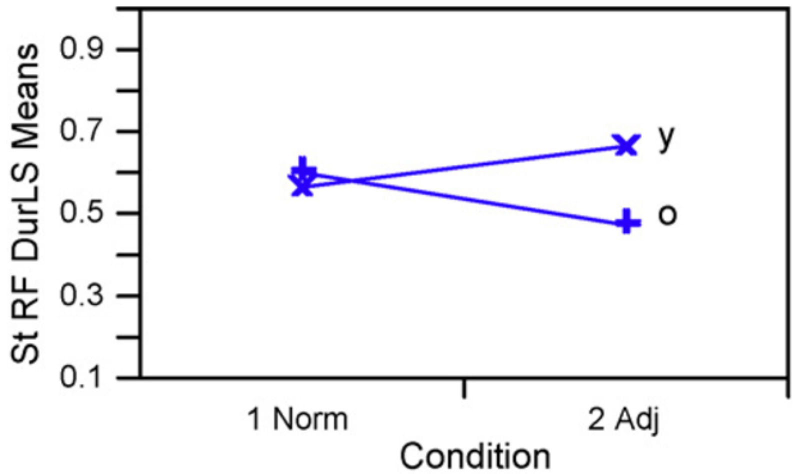

Fig. 7.
RF activity duration for younger and older persons.

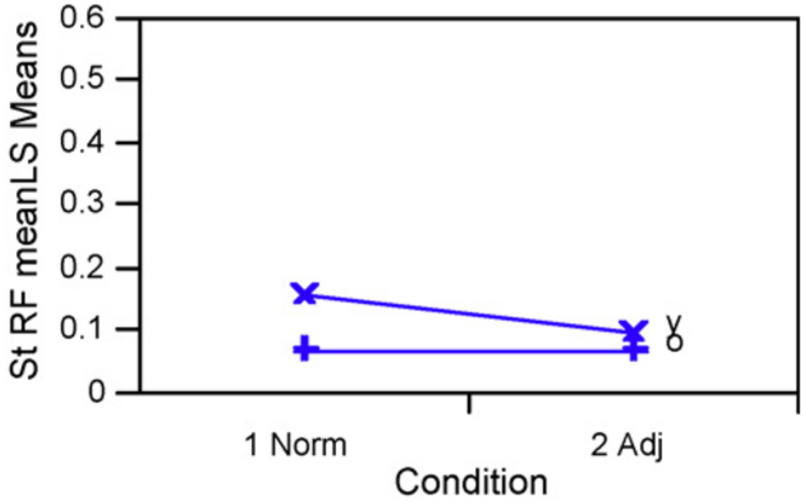

Fig. 8.
RF mean activity for younger and older persons.

Table 1

Participant characteristics (age, weight, and height)

	Young (19–35 years old), mean (S.D.)	Old (67–79 years old), mean (S.D.)
Age (year)	23.21 (4.41)	72.64 (4.36)
Weight (kg)	71.74 (11.97)	72.59 (16.31)
Height (cm)	172.41 (10.94)	168.49 (9.1)

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Table 2

Age by condition: RCOF, HCV, and step length

Measurement	Condition	Younger, mean (S.D.)	Older, mean (S.D.)
RCOF (F_H/F_v)	Normal	0.20 (0.02)	0.17 (0.02)
	Adjustment 1	0.16 (0.05)	0.11 (0.03)
	Adjustment 2	0.07 (0.02)	0.06 (0.03)
HCV (cm/s)	Normal	228.30 (41.27)	172.24 (63.70)
	Adjustment 1	207.14 (91.45)	84.16 (90.58)
	Adjustment 2	148.22 (103.55)	97.44 (98.10)
Step length (cm)	Normal	67.52 (6.31)	62.56 (7.02)
	Adjusted	55.52 (8.78)	46.96 (15.81)

Table 3

Overall activity characteristics of the quadriceps muscle group on the stance leg

Measurement condition	Normal		Adjusted	
	Younger	Older	Younger	Older
Duration (s)*	0.570000 (0.093240)	0.603600 (0.121766)	0.668400 (0.098991)	0.475200 (0.288995)
Peak (mV)	0.383857 (0.448687)	0.144429 (0.123802)	0.252071 (0.234978)	0.138571 (0.140369)
Mean (mV)*	0.159223 (0.155020)	0.068103 (0.053953)	0.101733 (0.088720)	0.068342 (0.049398)

*Significant at $\alpha = 0.05$.