SKILL ACQUISITION OCCURS DURING FALL-PREVENTIVE MOTOR REPONSE TRAINING

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INTRODUCTION

Older adults have a high incidence of trip-related falls that contribute to significant morbidity and mortality. A surrogate treadmill task has been proposed as a potential fall-preventive training tool for older adults. Successful motor response training must elicit stepping strategies as similar as possible to those evoked during actual trips and must demonstrate motor skill acquisition. Differences in the foot trajectories after an actual trip compared to those during the treadmill task have been attributed to the presence of an obstacle [1]. Recent work has shown that the addition of an obstacle to the surrogate treadmill task increases step height and step length to more closely approximate stepping responses elicited during an actual trip [2]. Older adults have demonstrated the ability to modify failed stepping strategies and successfully recover on the subsequent trial during the treadmill task without the obstacle [3], but little is known about the underlying motor control mechanisms regulating the acquisition of this skill.

The purpose of our study was to assess motor skill acquisition while participants successfully stepped over an obstacle during the surrogate treadmill task. We hypothesized that step height, trunk flexion, and trunk angular acceleration would decrease as subjects acquired the skill.

METHODS

Ten healthy young adults (7 females, 3 males) participated in the study (26.9 ± 5.04 yrs, 171.2 ± 6.47 cm). A surrogate trip was induced through sudden treadmill acceleration (maximum speed of 2.5 mph). Subjects were instructed to recover equilibrium and continue walking after the treadmill was unexpectedly activated. Fifty randomized stepping trials, 25 without an obstacle on the treadmill and 25 with a 5 cm obstacle placed 2.5 cm in front of the toes, were conducted. Whole body 3D kinematics were collected with an eight-camera motion capture system (Motion Analysis, Santa Rosa, CA). Maximum step height of the recovery (first leg to step) and trail limb (second leg to step), peak trunk flexion, and peak trunk angular acceleration in flexion and extension were compared between conditions (with, without obstacle) and between trials (trials 1-5 average, trials 20-25 average).

RESULTS AND DISCUSSION

A repeated measures MANOVA revealed a significant reduction in step height, trunk flexion, and trunk angular acceleration in flexion and extension between trials. In the obstacle condition, recovery and trail step height decreased from trials 1-5 (recover: 30.75 ± 5.85 cm; trail: 34.79 ± 5.77 cm) to trials 20-25 (recover: 27.31 ± 6.88 cm; trail: 30.22 ± 5.13 cm). Regardless of condition, participants demonstrated considerable decreases in trunk flexion and trunk angular acceleration with repetition illustrating skill acquisition of this novel task (Table 1). When subjects stepped over the obstacle, peak trunk flexion reached a steady state whereby further repetition did not result in less trunk flexion (Figure 1). This progressive reduction in peak trunk flexion indicates greater trunk control as trial number increases.

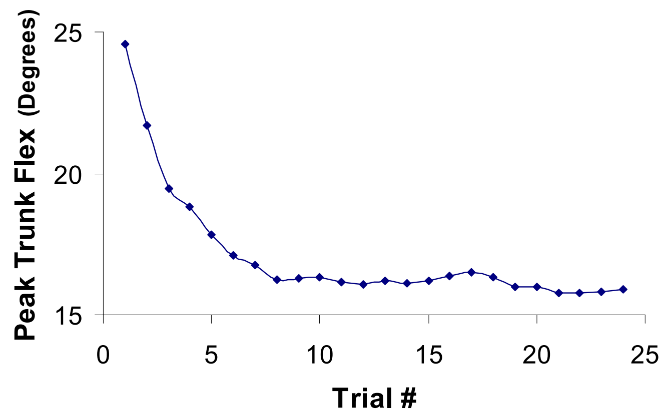

Figure 1: Running mean of peak trunk flexion versus trial number for a typical subject

CONCLUSIONS

Twenty-five trials using the surrogate treadmill task with the addition of an obstacle appears to be a more than adequate number of trials to illustrate improvements in foot and trunk control as a measure of skill acquisition. Decreased trunk flexion during tripping events may contribute to successful trip recovery [3] making it a desirable outcome of a fall-preventive training protocol. This work provides further direction in the design and development of a treadmill training protocol as an expedient and effective tool in training older adults how to avoid falling after large postural disturbances.

REFERENCES

1.Troy KL & M Grabiner. *Exp Brain Res* **Oct 23** [Epub], 2004.
2.Hamstra-Wright, KL et al. *J Athl Train*, in press.
3.Owings TM et al. *Clin Biomech* **16**, 813-819, 2001.

Table 1: Values represent means & standard deviations. *Significant ($p \leq .05$) decrease from trials 1-5 to trials 20-25.

Trunk Values Trials 1-5 versus Trials 20-25			
	Peak Trunk Flex (deg)	**Trunk Angular Acceleration Flex (deg/s^2)**	**Trunk Angular Acceleration Ext (deg/s^2)**
Trials 1-5	20.38 ± 7.13	1499.78 ± 494.44	-933.88 ± 627.71
Trials 20-25	16.57 ± 4.87	1209.64 ± 413.52	-734.15 ± 424.97
p value (1-5 vs 20-25)	*p = .01	*p = .00	*p = .05