OBSTACLE AVOIDANCE WITH VARYING ABILITY TO SPATAIALLY ORIENT ATTENTION FOLLOWING MILD TRAUMATIC BRAIN INJURY

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INTRODUCTION

Safety during motor tasks is imperative to decreasing the likelihood of permanent brain damage following mild traumatic brain injury (mTBI). Crossing over an obstacle is a real-world task that has revealed conservative adaptations by mild (Catena et al 2007) and severe TBI populations (McFadyen et al 2003). Reduced performance during this task could result in trips, and subsequent brain injuries. The spatial orientation component of attention allows for the disengagement, shift and reengagement of attention to quickly and accurately process information and formulate a response. Deficits in the spatial orientation of attention have been shown following mTBI (Halterman et al. 2006). Recently, obstacle avoidance during reaching has been proposed as a parietal lobe process (Schindler et al. 2004), similar to where spatial orientation of attention is said to occur. The purpose of this study was to examine how the spatial orientation of attention is correlated to obstacle crossing performance, specifically following mTBI and during recovery from such an injury.

METHODS

Seventeen grade II mTBI subjects were tested within 48 hours post-injury. Testing was repeated at 6, 14 and 28 days post-injury. Seventeen gender, age, stature and athletic participation matched controls were tested at four equivalent intervals. Markers located between the 2nd and 3rd metatarsals of each foot just proximal to the metatarsophalangeal joints were tracked with an 8-camera motion analysis system. Obstacle clearance heights (toe marker to obstacle) were measured for each foot during walking. Two walking tasks were conducted: single task obstacle-crossing at 10% of body height (OB), and with a concurrent attention dividing cognitive task (DOB). After each testing session, the spatial orienting of attention was measured with an Attentional Network Test (ANT). Linear regressions were performed between the spatial orientation of attention effect size and each obstacle crossing parameter during each day and within each group. Two-way ANOVAs were performed between group and day for each task.

RESULTS AND DISCUSSION

Individuals following mTBI demonstrated deficits in spatial orientation only at the first testing session. No significant group differences were detected for obstacle clearances.

Without a secondary cognitive task, only lead clearance over an obstacle seems to have a significant relationship with an ability to spatially orient attention following an mTBI. Specifically, obstacle clearance height (OC) was directly related to an ability to effectively spatially orient attention following an mTBI, but not in healthy individuals (Table 1). The relation between spatial orientation of attention and obstacle crossing clearance exhibited signs of decreasing as healing progressed.

While performing a secondary cognitive task, both lead foot and trailing foot clearance over an obstacle seems to have a significant relationship with an ability to spatially orient attention following an mTBI. We found that obstacle clearance heights of both feet are directly related to an ability to effectively spatially orient attention following an mTBI, but not in healthy individuals (Table 1). The relation between spatial orientation of attention and obstacle clearance also tended to decrease as healing progressed.

The results from this study indicate that as one is able to spatially orient attention better, the lead foot is lifted higher to avoid obstacle contact. This could prove important for mTBI subjects that have been shown to suffer from deficits in the spatial orientation of attention immediately following an injury. When attention is divided, there is a significant relationship between obstacle clearance of each foot and increased spatial orientation. As one is able to spatially orient attention better, both feet are lifted higher over the obstacle. This would seem to indicate that mTBIs use a more conservative strategy for crossing with both feet when attention is divided but spatial orientation of attention is still intact. One caveat to these results is that the spatial effect was usually only able to predict around 27% of the variance in each of the mentioned variables. This leaves other factors to play an important role in obstacle clearance parameters, including natural human variation.

SUMMARY/CONCLUSIONS

Measuring a concussed individual's ability to avoid obstacles is of particular relevance, but may not always be feasible in clinical examinations. This study may support the use of either one of these tests to predict performance in the other following mild traumatic brain injury.

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Table 1: R^2 values reported indicate the linear relationship between spatial orientation of attention and the given obstacle variable for the given task, group and day. *P*-values are shown in parentheses.

Task	Foot Clearance	Group	Time (days)			
			<2	5-7	13-15	27-29
OB	Lead	mTBI	**.294 (.037)**	**.282 (.028)**	.176 (.093)	.182 (.100)
		Cont.	.041 (.455)	.055 (.382)	.073 (.293)	.017 (.618)
DOB	Lead	mTBI	**.477 (.004)**	.099 (.218)	.094 (.232)	.185 (.096)
		Cont.	.045 (.411)	.005 (.801)	.131 (.153)	.029 (.514)
	Trailing	mTBI	**.265 (.050)**	.174 (.095)	.048 (.396)	.050 (.486)
		Cont.	.080 (.273)	.055 (.382)	.044 (.418)	.054 (.370)