MAINTENANCE OF GAIT STABILITY IN CONCUSSED COLLEGE PATIENTS DURING DUAL TASKS

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INTRODUCTION

According to Kahnemn's [2] model of information processing, processing capacity in humans is limited. When two tasks are presented to an individual, the desired outcome(s) will occur so long as the capacity of the system has not been exceeded. Once the capacity has been reached, there will be a decline in performance in one or all tasks. It has been estimated that, between the ages of 15-24 years, 133 people out of 100,000 will receive a traumatic brain injury (TBI) each year [3]. This accounts for 31.7% of all concussions. The maintenance of dynamic stability while perturbed by different secondary tasks is crucial day by day. Motor perturbations have been previously described to have significant detrimental effects on a TBI population [1]. To date, there have been no studies measuring a simple reaction time, a cognitive, and a motor dual-task with level walking, specifically in a concussed population. Our study looked to determine how different secondary tasks affect dynamic stability of patients with concussion and how balance is maintained during each task.

METHODS

Subjects (Conc), n=11, were identified as suffering a grade II concussion within 48 hours of collection. Controls (Norm), n=8, were matched by gender, age, and stature. The whole body motion data were collected with an 8camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA) during gait. Twenty-nine reflective markers were placed on bony landmarks. A thirteen-link model was created, each with the segmental center of mass (CoM) defined according to Winter [4]. The whole-body CoM was calculated using the weighted sum of each segment [1]. Center of pressure (CoP) location was found with two force plates (AMTI, Watertown, MA). The collection was divided into three parts. The single task session (level) was walking without a concurrent task. The first dual task session (OB) required crossing an obstacle at 10% of body height midway down the walkway. The second dual task session (COG) added in a cognitive task (e.g. backward digit span, spelling backwards) to level walking. Then the 3rd dual task session added a simple reaction time test (RT on) that was imposed with random catch trials (RT off) while walking. During RT trials, the subject responds to an audio perturbation by pressing a button on a wireless remote.

Gait temporal-distance parameters as well as the maximum CoM-CoP separation distances and the time-corresponding CoM linear velocities in the anterior-posterior (A/P) and medio-lateral (M/L) directions were examined [1]. 2x5 ANOVA's with repeated measures were used to assess the differences between tasks and groups. If there was a significant difference ($p<.05$), a post-hoc pairwise comparison was completed to find between which specific tasks there was significance.

RESULTS AND DISCUSSION

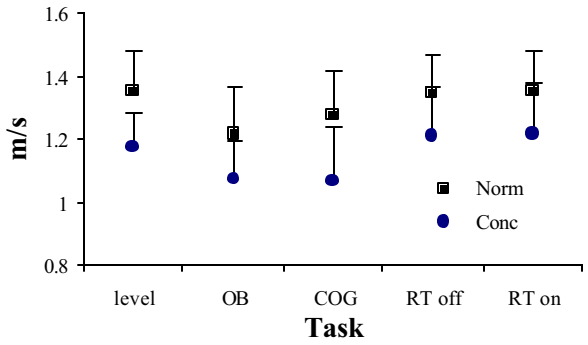

Figure 1. Average Gait Velocity in each task

Significant task effects between OB and level ($p<.001$) and COG and level ($p=.016$) were seen in gait velocity (Figure 1). A significant group effect was also seen ($p=.018$). Norms showed task effects only between OB and level walking for A/P CoM-CoP maximum separation ($p=.029$), and CoM velocity at A/P max separation ($p=.015$). Concs showed significant effects between OB and level walking for A/P range of motion (RoM) ($p=.001$), M/L RoM ($p=.023$), A/P CoM-CoP max separation ($p<001$), and CoM velocity at A/P max separation ($p<.001$). Concs also showed significant effects between COG and level walking for CoM velocity at A/P CoM-CoP max separation ($p=.045$). Even more interesting is that there seem to be differences in Concs between COG and OB for some gait stability parameters. A/P CoM-CoP max separation ($p=.002$) and velocity at M/L CoM-CoP max separation ($p=.025$) are both greater in the OB task.

CONCLUSIONS

Our study shows that a concussion has effects on normal gait regardless of single or dual tasks. Within both groups, only the more difficult tasks have shown to perturb gait stability, leading us to believe there is an attentional deficit in concussed patients. There also seems to be different compensatory actions taken by the individuals with a concussion to overcome these attentional deficits when faced with different types of dual-task situations.

REFERENCES

1. Chou LS, et al. 2004. Gait and Posture. 20:245-54
2. Kahnemn D. 1973. Attention and Effort.
3. Novack T. 1999. TBI facts and stats. Proceedings of the Recovery after TBI Conference.
4. Winter DA. 1990. Biomechanics and Motor Control of Human Movement. Wiley, New York, pp.56-7.

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