Visuomotor coordination markers of neural function in pilots and crew following post fast boat exposure

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Summary

The specific aim was to examine the level of neurological impairment due to repetitive loading in fast boat operations. We examined visuomotor coordination pre and post-fast boat exposure. The results demonstrated changes in circular smooth pursuit, horizontal smooth pursuit, vertical smooth pursuit, horizontal saccades, and vertical saccades, indicating increased impairment and the influence of repetitive loading on neural function. Results are discussed in relation to known visuomotor coordination deficits in individuals with mTBI.

Introduction

Repeated exposure to whole-body vibrations and excessive g-forces by military personnel has resulted in detrimental short and long-term neurological and musculoskeletal effects of repetitive loading. Repetitive loading even at relatively low loads has the potential to cause significant neurological dysfunction. In military operators regularly exposed to these excessive g-forces, there is an increase in the self-reporting of symptoms such as headaches, poor concentration, neck pain, lower leg and back injury, and factors related to mTBI, and evidence for impaired reaction time, physical and neurocognitive performance [1]. Ideally, work in this area would be to directly measure neural damage associated with fast boat exposure. The purpose of this project was to characterize changes in biomechanical and sensorimotor markers on personnel after fast boat exposure.

Methods

Six participants (18-36 years) completed a standard duty underway as either fast boat operators or crew while having head, body, and vessel accelerations recorded. Participants also completed a demographic survey to assess previous head injury and a visuomotor coordination test pre and post-underway. An HTC VIVE virtual reality (VR) headset with an integrated Tobii Pro infrared eye-tracking system was used to measure visuomotor coordination and ground reaction forces calculated from Novel Pedar in-sole pressure system. , Visuomotor coordination was examined through circular smooth pursuit (CSP), horizontal smooth pursuit (HSP), vertical smooth pursuit (VSP), horizontal saccades (HSA), and vertical saccades (VSA) paradigms with the VR headset. Cohen's *d* was used to determine effect size (ES) and meaningfulness of the findings.

Results and Discussion

The results demonstrated increases in angular velocity (ES = .64), root mean square error (ES = .23), and sample entropy (ES = 1.01) for circular smooth pursuit (See Figure 1). Similar findings were found for HSP, VSP, HAS, and VSA (ES ranged from .23 - .84). The changes in angular velocity, error, and sample entropy indicate a decreased visuomotor coordination.

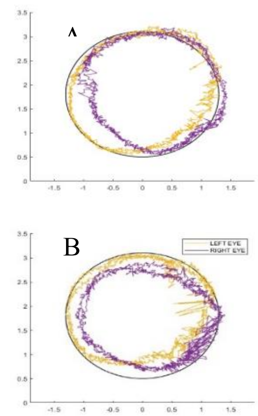

Figure 1: Exemplary Circular Smooth Pursuit Pre (A) and Post (B) underway.

Conclusions

Overall, this finding aligns with our previous work in mTBI in which individuals with neural impairment demonstrated an increased variability in circular smooth pursuit metrics, fixation stability, pursuit score, and gaze radius. The findings also demonstrate that repetitive sub-concussive impact will influence visuomotor coordination and may indicate future neural impairment.

Acknowledgments

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References

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