

ABSTRACT:

Objectives: Control of balance requires complex integration of sensory and motor systems. In the clinic or in the field, balance measurement is often over-simplified, preventing balance deficits from being identified and treated after mTBI. Our central hypothesis is that chronic balance deficits after mTBI result from impairments in central sensorimotor integration that may be helped by rehabilitation. There are two objectives of this proposal; the first objective is to characterize balance deficits in people with mTBI. The second objective is to use a novel ABF device to improve measures central sensorimotor integration and balance control.

Plan: The proposed 4-year study has two parts: 1) Cross-sectional study (Aim I: Balance Assessment) to identify and characterize maladaptive balance control strategies after mTBI compared to healthy controls and 2) Interventional randomized pilot study (Aim II: Balance Rehabilitation) using a novel ABF rehabilitation technique to ameliorate maladaptive balance control strategies after TBI. Subjects in Aim II will be a subset from Aim I and studies will occur simultaneously.

Methods: I) Balance Assessment: To characterize balance deficits in people with mTBI who have chronic, non-resolving balance deficits compared to healthy control subjects without a history of mTBI. We hypothesize that a) objective measures of central sensorimotor integration, static and dynamic balance will better distinguish people with mTBI from control subjects than clinical measures, b) a subset of people with mTBI will have abnormal CSMI test measures, even without peripheral vestibular or ocular motor deficits c) the relationship between poorer static/dynamic balance performance and mTBI is regulated/mediated by CSMI. We will test 130 subjects between the ages of 21 and 50; 65 with chronic (> 3 months) mTBI and non-resolving balance deficits and 65 healthy age and gender matched control subjects without a history of mTBI. We will obtain objective measures of static and dynamic balance using wearable inertial sensors and determine how these measures relate to central sensorimotor integration. We will also obtain laboratory measures of peripheral vestibular function and ocular motor function to help classify people and to consider as potential covariates in rehabilitation efficacy.

II) Balance Rehabilitation: To determine the efficacy of a novel, ABF balance rehabilitation program to improve central sensorimotor integration, static and dynamic balance, and functional activity in patients with chronic mTBI. We hypothesize that a) CSMI scores will improve with rehabilitation and ABF will increase the improvement of CSMI scores beyond the standard of care, b) ABF intervention will improve objective summary measures of balance and c) people with central sensorimotor integration impairment will show sustained improvement in CSMI scores and balance after rehabilitation. We will randomize 40 subjects between the ages of 21 and 50; 65 with chronic (> 3 months) mTBI and non-resolving balance deficits from Aim I who have abnormal CSMI into either the ABF rehabilitation group or the standard of care group. People will be tested before and after a 6-week intervention period and again 6 week later to determine long-term changes. Normal/abnormal vestibular and ocular motor

function will be used as covariates to determine if peripheral deficits affect the efficacy of ABF rehabilitation.

Relevance to VA's Mission: These proposed studies have the potential to change the way in which military personnel are assessed and rehabilitated after mTBI. When this project is completed, we expect to have shown that central sensory integration for balance control is impaired in people with chronic mTBI. We will demonstrate how portable, body-worn sensors can be used to characterize problems and rehabilitate balance using novel ABF. Findings from this research can be very readily adopted into military balance screening in the field post mTBI as well as for better military and civilian balance rehabilitation.

Medical Subject Heading (MeSH) terms: Balance, mTBI, Rehabilitation