AWARD NUMBER: W81XWH-22-1-0664

TITLE: Visual-Motor Coordination Assessments for Patients with Chronic Ankle Instability: Decision Support Tools to Optimize Return to Duty

PRINCIPAL INVESTIGATOR: Matthew C. Hoch, PhD, ATC

CONTRACTING ORGANIZATION: University of Kentucky, Lexington, KY

REPORT DATE: October 2023

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	**2. REPORT TYPE**	**3. DATES COVERED**
October 2023	Annual	01Sep2022-31Aug2023

4. TITLE AND SUBTITLE
Visual-Motor Coordination Assessments for Patients Chronic Ankle Instability: Support Tools to Optimize Return to Duty

5a. CONTRACT NUMBER
W81XWH-22-1-0664

5b. GRANT NUMBER
OR210091

5c. PROGRAM ELEMENT NUMBER
Blank

6. AUTHOR(S)
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5d. PROJECT NUMBER
Blank

5e. TASK NUMBER
Blank

5f. WORK UNIT NUMBER
Blank

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

Blank

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

10. SPONSOR/MONITOR'S ACRONYM(S)

Blank

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

Blank

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

13. SUPPLEMENTARY NOTES
Blank

14. ABSTRACT
Lateral ankle sprains account for a large proportion of musculoskeletal injuries among civilians and service members with up to 40% of patients developing chronic ankle instability (CAI). The purpose of this study is to establish a novel outcomes assessment paradigm focused on visual-motor coordination (VMC) in patients with CAI. This study will establish a series of novel VMC assessments that can be used as decision support tools to optimize return to duty following lateral ankle sprain injuries. This study will provide *short-term impact* by providing a new testing battery which will provide clinically feasible assessments to gauge readiness for return to tactical environments for patients with LAS or CAI. The *long-term impact* will be related to the expansion of the rehabilitation paradigm because of the VMC deficits identified using these outcomes. Based on our preliminary work, we expect the VMC assessments will more effectively identify residual motor dysfunction (Aim 1), exhibit associations with brain connectivity, cognitive performance, and injury-related fear (Aim 2), and demonstrate strong test-retest reliability in CAI patients (Aim 3). The successful execution of these aims will facilitate the long-term goal of this research agenda which is to develop a novel evaluation and rehabilitation strategies that improve the immediate and long-term health of warfighters with CAI.

15. SUBJECT TERMS
Ankle Injuries; Perception; Sensorimotor; Return-to-duty; Secondary Prevention

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			USAMRDC
Unclassified	Unclassified	Unclassified	Unclassified	11	**19b. TELEPHONE NUMBER** *(include area code)*

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1. INTRODUCTION:

Lateral ankle sprains account for a large proportion of musculoskeletal injuries among civilians and service members with up to 40% of patients developing chronic ankle instability (CAI). The purpose of this study is to establish a novel outcomes assessment paradigm focused on visual-motor coordination (VMC) in patients with CAI. This study will establish a series of novel VMC assessments that can be used as decision support tools to optimize return to duty following lateral ankle sprain injuries. This study will provide *short-term impact* by providing a new testing battery which will provide clinically feasible assessments to gauge readiness for return to tactical environments for patients with LAS or CAI. The *long-term impact* will be related to the expansion of the rehabilitation paradigm because of the VMC deficits identified using these outcomes. Based on our preliminary work, we expect the VMC assessments will more effectively identify residual motor dysfunction (Aim 1), exhibit associations with brain connectivity, cognitive performance, and injury-related fear (Aim 2), and demonstrate strong test-retest reliability in CAI patients (Aim 3). The successful execution of these aims will facilitate the long-term goal of this research agenda which is to develop a novel evaluation and rehabilitation strategies that improve the immediate and long-term health of warfighters with CAI.

2. KEYWORDS:

Ankle Injuries; Perception; Sensorimotor; Return-to-duty; Secondary Prevention

3. ACCOMPLISHMENTS:

What were the major goals of the project?

	Timeline	% Complete
Major Task 1: Administrative Objectives	**Months**	
Subtask 1.1: Human Subject Protection Approvals		
Refine inclusion/exclusion criteria, and recruitment procedures	1-6	100%
Coordinate with University of Kentucky (UK) Office of Research Integrity for submission of institutional review board (IRB) materials		100%
Complete human subjects protections training or other research training modules		100%
Prepare consent and research protocol documents for local and military IRB submissions (UK, ORHO)		100%
Milestone Achieved: All human subject approvals received at civilian and military levels		***Complete***
Subtask 1.2: Hiring UK Graduate Research Assistant/ Post-Doctoral Scholar		
Coordinate hiring process with College of Health Sciences Human Resources/ Graduate School	1-6	100%
Draft position announcements for graduate research assistant and post-doctoral scholar		100%
Advertise and interview candidates		100%
Complete kick off meeting, orientations, training- standard operating procedures, study procedure training for recruitment, consenting, data collection, and processing procedures	6-9	100%
Milestone Achieved: GRA/PDS hired, kick off meeting held, and operational activities identified		
Subtask 1.3: Reporting		
Submit quarterly reports to United States Army Medical Research & Material Command (USAMRMC)	Quarterly	Ongoing
Submit annual reports to USAMRMC	Annually	Ongoing
Submit annual IRB continuation renewals	Annually	Ongoing
Participate in In Progress Review	Once	Not Complete

Submit protocol amendments, adverse event, and other as needed	As Need	Ongoing
Submit final report to USAMRMC (3 months post award)	Post Award	Not Complete
Milestone Achieved: All required reporting completed		
Major Task 2: Technical Objectives	**Months**	
Subtask 2.1: Data Recruitment and Collection (See Figure 1 for Flow Diagram)		
Finalize assessment measurements and standard operating procedures	1-6	100%
Implement subject recruitment procedures for chronic ankle instability and healthy control groups	9-21	100%
Milestone Achieved: Data collection initiated		
Complete informed consent and initial data collection of tradition and visual motor coordination measures (healthy and chronic ankle instability groups (n=120).	9-42	23%
Complete MRI scans, tablet-based cognitive tests, and injury-related fear questionnaires in chronic ankle instability group only (n=60)	9-42	15%
Complete follow-up data collection for reliability of visual-motor coordination measures in chronic ankle instability group (n=60)	9-42	5%
Complete data quality and control procedures	9-45	Ongoing
Milestone Achieved: Data collection complete		
Subtask 2.2: Data Processing, Analysis, and Dissemination		
Create data quality control plan and data entry platform	1-6	100%
Data processing	9-42	5%
Complete data processing	42-45	0%
Data interpretation and dissemination- prepare and submit abstracts/manuscripts for peer-reviewed publication	24-48	0%
Attend professional scientific conferences (civilian and military) – 2 investigators per year	Annually Year 2-4	0%
Milestone Achieved: Project complete		

What was accomplished under these goals?

During the first year of the project, the primary focus of the research team was to complete Major Task 1: Administrative Objectives. The specific objectives pursued under this major activity has been attaining human subject protection approvals. The team has made progress towards this objective by achieving all approvals from the University of Kentucky IRB and USAMRDC ORHO.

During this year we also successfully interviewed, offered, and hired a post-doctoral scholar and research analyst. These hires are critical to study execution; particularly as the study moves into pursuit of Major Task 2: Technical Objectives.

The research team finalized the MOP for study procedures, SOP for all outcome measures, piloted laboratory methods, and developed the data entry platform. The research team was also granted approval to add additional motion capture instrumentation to the study which is providing more granularity in movement behaviors during each assessment. This equipment was successfully integrated into the protocol and is operational for data collection. The team continually reviews procedures related to enrollment, human subject safety requirements, documentation, and a continued communications plan.

The remaining milestones under Major Task 1 are related to project reporting and will be completed over the project duration.

During this year, the research team has continued to make progress on Major Task 2: Technical Objectives. Data collection was initiated in Quarter 3 of this year. At the beginning of Quarter 4, portions of the building adjacent to our laboratory went under construction for a longer than anticipated time which paused testing. However, the research team focused on expanding recruitment opportunities and planning for the Fall 2023 semester. To date, the research team has enrolled 28 participants (11 CAI, 17 Healthy) with 16 completed with the study, 6 ongoing follow-up testing, and one withdrawal. The research team is pleased with this progress based on our projection to enroll 10 participants by the end of project Year 1. The research team will continue making progress on this Task by continuing recruitment, enrollment, data collection, and data analysis in the upcoming reporting cycles.

What opportunities for training and professional development has the project provided?
Nothing to Report.

How were the results disseminated to communities of interest?
Nothing to Report.

What do you plan to do during the next reporting period to accomplish the goals?
In the next reporting period, the primary focus will be executing the items under Major Task 2: Technical Objectives. Specifically, subject recruitment and data collection activities will be the emphasis of the next reporting period. The team will also stay current on data processing activities as applicable.

4. IMPACT:

What was the impact on the development of the principal discipline(s) of the project?
Nothing to Report.

What was the impact on other disciplines?
Nothing to Report.

What was the impact on technology transfer?
Nothing to Report.

What was the impact on society beyond science and technology?
Nothing to Report.

5. CHANGES/PROBLEMS:

Changes in approach and reasons for change
Nothing to Report.

Actual or anticipated problems or delays and actions or plans to resolve them
Parts of the building adjacent to the laboratory were under construction for approximately 2 months which resulted in considerable noise and vibration daily. This caused a pause in data collection until the work was completed. Since this pause, enrollment has been very strong and we able to meet our Year 1 goals. No further impact is expected.

Changes that had a significant impact on expenditures
Nothing to Report,

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Significant changes in use or care of human subjects
SUBMITTED TO AND APPROVED BY:

- University of Kentucky IRB (Approved: 6/10/22, IRB #76922)
    - Continuation Review (Approved: 4/23/23)
- USAMRDC ORP HRPO (Approved: 7/15/22, Log Number E03481.1a)

No significant changes to report since project initiation.

Significant changes in use or care of vertebrate animals
Not Applicable.

Significant changes in use of biohazards and/or select agents
Not Applicable.

6. PRODUCTS:

Publications, conference papers, and presentations

Journal publications.
Nothing to Report.

Books or other non-periodical, one-time publications.
Nothing to Report.

Other publications, conference papers and presentations.
Nothing to Report.

Website(s) or other Internet site(s)
Nothing to Report.

Technologies or techniques
Nothing to Report.

Inventions, patent applications, and/or licenses
Nothing to Report.

Other Products
Nothing to Report.

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name: Matthew Hoch, PhD, ATC
Project Role: PI
Researcher Identifier (e.g. ORCID ID): 0000-0002-6268-1804
Nearest person month worked: 3
Contribution to Project: Dr. Hoch is the principal investigator directly overseeing research activities at the University of Kentucky and is responsible for overall project execution.

Name: Danielle Torp, PhD, ATC
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 2
Contribution to Project: Dr. Torp has been responsible for recruitment, enrollment procedures, and data collection.

Name: Johanna Hoch, PhD, ATC
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Hoch is overseeing recruitment, subject screening, and assisting with interpretation of visuomotor data.

Name: Nicholas Heebner, PhD, ATC
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Heebner is assisting with data collection and analysis related to biomechanical data.

Name: Kyle Kosik, PhD, ATC
Project Role: Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Kosik is responsible for data collection, data analysis, and subject recruitment.

Amelia Leicht, PhD
Project Role: Post-Doctoral Scholar
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 2
Contribution to Project: Dr. Leicht is responsible for data collection, data analysis, and subject retention.

Name: Phillip Gribble, PhD, ATC
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Gribble assists with subject recruitment and biomechanical interpretation.

Name: Ke'La Porter, MS, ATC
Project Role: Research Analyst
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 3
Contribution to Project: Ms. Porter assists with MRI collection and processing and visuomotor assessment.

Name: Nathan Johnson, PhD, DPT
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Johnson oversees MRI data collection and interpretation.

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Key personnel including Heebner (co-PI), Gribble (co-PI), and J Hoch were awarded the grant below since initiation of this project.

Title: Safety, Health, and Injury Mitigation in Firefighter Training (SHIFT)
Supporting Agency: Federal Emergency Management Agency
Performance Period: 07/01/2022 – 06/30/2025
Level of Funding:
Goals: The purpose of this proposal is to examine specific mechanisms of MSI sustained by firefighters, establish the impact that HCPs have in mitigating time-loss from MSI and identify barriers to future implementation of the HCP direct access model.
Specific Aims: 1) Explore the lived experiences of firefighters and HCPs to identify MSI mechanisms of injured firefighters; 2) Compare MSI-related time-loss and financial outcomes between departments with and without HCP direct access; 3) Identify barriers to implementation of the direct access model from key stakeholders in the Fire Service.
Point of Contact: TBD

Key personnel including Kosik (PI), Torp, and M Hoch were awarded the grant below since initiation of this project which will start 9/30/23.

Title: REvealing the Progression of Pain Pathways and Identifying Chronification Of Pain Predictors After an Isolated Lateral Ankle Sprain: Project RECOIL
Supporting Agency: Department of Defense
Performance Period: 8/1/2023 to 7/31/2027
Level of Funding:
Goals: The *long-term goal* for our multidisciplinary team is to improve the quality of life and level of function
for all Americans by reducing pain and disability after a LAS through rehabilitation.
Specific Aims: Aim 1: Quantify the prevalence rate of chronic ankle pain and healthcare utilization patterns at 6-months and 12-months after a LAS. Aim 2: Compare mechanical pain sensitivity levels, pain facilitation and inhibition levels between participants who do and do not develop chronic pain at 6- and 12-months after a LAS. Aim 3: Identify comorbid conditions, clinician outcomes and patient-reported outcomes that are predictive of chronic ankle pain at 6-months and 12-months after a LAS.
Point of Contact: TBD
Overlap: None

Key personnel including Heebner (PI), Torp, Kosik, Gribble, and M Hoch were awarded the grant below since initiation of this project which will start 9/30/23.

Title: Performance and Job Task Demands of Special Tactics Support Airmen
Supporting Agency: Air Force Research Laboratories
Performance Period: 10/2023 – 10/2026
Level of Funding:
Goals: The scientific approach and development of an occupational task analyses, physical assessment, and intervention selection framework to enable AFSOC and USAF commands to quantify the physical capacities required for specific occupational specialties that would be needed to inform physical readiness standards and develop MOS-specific physical readiness training program tailored for these warfighters.
Specific Aims: Aim 1: Use historical data to quantify musculoskeletal injury patterns and reported mechanisms within ST support airmen; Aim 2: Profile the physical and physiological demands of ST support airmen during a variety of training activities (at the unit and in remote training environments);
Aim 3: Develop a preliminary framework that the broader Air Force can use to conduct a job task analysis within any unit or MOS and generate intervention action plans.
Point of Contact: pending
Overlap: None

What other organizations were involved as partners?
Nothing to Report.

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS: N/A

QUAD CHARTS: A Quad Chart was uploaded as a separate file.

9. APPENDICES:

None to Report.