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TITLE: Optimizing Clinical Outcomes for Patients with Chronic Ankle Instability Using Foot Intensive Rehabilitation (FIRE)

PRINCIPAL INVESTIGATOR: Matthew C. Hoch, PhD, ATC

CONTRACTING ORGANIZATION: University of Kentucky

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6. AUTHOR(S)
Hoch, Matthew; Fraser, John; Hertel, Jay; Hoch, Heebner, Nicholas; Gribble, Phillip; Thompson, Katherine; Sessoms, Pinata; Hu, Yaowen
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

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

University of Kentucky
Research Foundation
500 S Limestone
109 Kinkead Hall
Lexington, KY 40526

8. PERFORMING ORGANIZATION REPORT NUMBER

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

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1 3. SUPPLEMENTARY NOTES

14. ABSTRACT
The purpose of this randomized controlled trial is to determine if a novel Foot Intensive Rehabilitation (FIRE) protocol has the potential to create more effective clinical outcomes compared to SOC rehabilitation for patients with CAI. This study will use a multisite, single-blinded, randomized controlled trial design with data collected at the University of Kentucky, University of Virginia, and Naval Hospital Camp Pendleton. A total of 150 CAI patients (50 per site) will be randomly assigned to one of two groups (FIRE or SOC). Patients in both groups will complete a 6-week intervention composed of supervised and home exercises. Patients assigned to SOC will complete exercises focused on ankle strengthening, balance training and range of motion. Patients assigned to FIRE will complete a modified SOC program along with exercises focused on intrinsic foot muscle activation, dynamic foot stability, and plantar cutaneous stimulation. All participants will complete testing at baseline, post-intervention, 6-month follow-up, 12-month follow-up, and 24-month follow-up to assess variables related to recurrent injury, sensorimotor function, and self-reported function.

15. SUBJECT TERMS
Ankle Injuries; Muscles; Sensation; Therapeutics; Secondary Prevention

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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). Although foot function is compromised in patients with CAI, these impairments are not routinely addressed by current standard of care (SOC) rehabilitation protocols, potentially limiting their effectiveness. The purpose of this randomized controlled trial is to determine if a novel Foot Intensive Rehabilitation (FIRE) protocol has the potential to create more effective clinical outcomes compared to SOC rehabilitation for patients with CAI. This study will use a multisite, single-blinded, randomized controlled trial design with data collected at the University of Kentucky, University of Virginia, and Naval Hospital Camp Pendleton. A total of 150 CAI patients (50 per site) will be randomly assigned to one of two groups (FIRE or SOC). Patients in both groups will complete a 6-week intervention composed of supervised and home exercises. Patients assigned to SOC will complete exercises focused on ankle strengthening, balance training and range of motion. Patients assigned to FIRE will complete a modified SOC program along with exercises focused on intrinsic foot muscle activation, dynamic foot stability, and plantar cutaneous stimulation. All participants will complete testing at baseline, post-intervention, 6-month follow-up, 12-month follow-up, and 24-month follow-up to assess variables related to recurrent injury, sensorimotor function, and self-reported function. This study will compare the effects of a novel FIRE program to a SOC program on near- and long-term functional outcomes in patients with CAI. We posit that the FIRE intervention will reduce the occurrence of future ankle sprains and ankle giving way episodes and create clinically relevant improvements in sensorimotor function and self-reported disability beyond the SOC intervention alone. This study will also provide longitudinal evidence of FIRE or SOC for up to two years by assessing the ability of rehabilitation to reduce subsequent injuries, diminish CAI-related impairments, and improve patient-oriented measures of health which is critical for the immediate and long-term health of civilians and service members with this condition.

2. KEYWORDS:

Ankle Injuries; Muscles; Sensation; Therapeutics; Secondary Prevention

3. ACCOMPLISHMENTS:

What were the major goals of the project?

	Timeline	Status	% Complete
Major Task 1: Administrative Objectives	**Months**		
Refine inclusion/exclusion criteria, and recruitment procedures	1-3	Complete	100%
Coordinate with civilian and military research protection offices for submission of IRB materials		Complete	100%
Complete additional CITI or other research training modules		Complete	100%
Prepare consent and research protocol documents for civilian and military IRB submissions (UK, UVA, NHRC, HRPO)- single IRB to UK as master submission		Complete	100%
Milestone Achieved: All human subject approvals received at civilian and military levels		***Complete***	
Coordinate research associate hiring process with Leidos	1-6	Complete	100%
Draft position announcements for research associate and graduate research assistants through national posting		Complete	100%
Advertise and interview candidates		Complete	100%
Complete kick off meeting, orientations, training- standard operating procedures, study procedure training for recruitment, consenting, data	6-9	In Progress	100%

collection, and processing procedures			
Milestone Achieved: NHRC/CP research associate hired, kick off meeting held, and operational activities identified		***Complete***	
Submit quarterly reports to USAMRDC	Quarterly	Ongoing	
Submit briefings to NHRC/NHCP Command Leadership	Ad Hoc	Ongoing	
Submit annual reports to USAMRDC	Annually	Ongoing	75%
Submit annual IRB renewals (IRB-UK Master)	Annually	Complete	75%
Submit technical report and knowledge products to NHCP Command Leadership and Physical Therapy and Sports Medicine Specialty Leaders	45-48	Not Complete	0%
Participate in In Progress Review	Once	Complete	100%
Submit final report to USAMRDC (3 months post award)	Post Award	Not Complete	0%
Milestone Achieved: All reporting completed as required		Not Complete	
Major Task 2: Technical Objectives	**Months**		
Finalize assessment measurements and SOP	1-3	Complete	100%
Implement subject recruitment procedures for FIRE and SOC groups	9-21	In Progress	100%
Conduct UVA/NHCP site visits	Semi-annual	Complete	100%
Milestone Achieved: Data collection initiated		Not Complete	
Complete informed consent and baseline data collection	9-21	Not Complete	61%
Complete FIRE or SOC intervention	9-21	Not Complete	44%
Complete post-intervention testing	9-21	Not Complete	44%
Complete 6 month follow up testing	15-27	Not Complete	21%
Complete 12 month follow up testing	21-33	Not Complete	8%
Complete 24 month follow up testing	33-45	Not Complete	0%
Complete data quality and control procedures	9-45	Not Complete	0%
Milestone Achieved: Data collection complete		Not Complete	
Complete data processing and analysis- statistics	9-48	Not Complete	35%
Data interpretation and dissemination- prepare and submit abstracts/manuscripts for peer-reviewed publication	36-48	Not Complete	25%
Attend professional scientific conferences (civilian and military) – 2 investigators per year	Annually Year 1-3	Not Complete	33%
Milestone Achieved: Project complete			

What was accomplished under these goals?

During the third year of the project, the primary focus of the research team was to make significant progress in pursuit of Major Task 2: Technical Objectives. Following Year 2, the team had enrolled 49 subjects (University of Kentucky (n=21), Camp Pendleton (n=22), University of Virginia (n=6)). As of this report date, 92 subjects have been enrolled (UK (n=36), Camp Pendleton (n=31), University of Virginia (n=25). Of this 92, 66 completed their assigned intervention, 16 are currently in the intervention, and 10 withdrew prior to completing the intervention. Additionally, the number of subjects completing 6-month (n=31) and 12-month (n=12) follow-up collections has increased. No subjects have reached the 24-month follow-up but these will begin to be reported in the upcoming project year.

Intervention compliance has remained high. Compliance with supervised and home sessions has been 90±14% and 65±29%, respectively. We believe these continued compliance rates; particularly for the supervised sessions, indicate that participants are engaged regardless of their assignment to FIRE or SOC groups and perceive the intervention programs as meaningful. Compliance data will continue to be monitored.

The research team has also increased efforts to begin dissemination from this study. To date, the research team has published a study protocol manuscript and has presented three abstracts. Abstracts were presented at the National Athletic Trainer's Association Free Communications Session in poster and podium format. An additional abstract was presented as a poster at the MHSRS. In addition to these activities, Drs. Hoch and Hertel led a Learning Lab format presentation at NATA which encompassed a 1-hour lecture and 1-hour hands-on laboratory session on the content supporting this project. Ten members of the study team were present to assist with the hands-on portion of the session which provided attendees with expert access to learning our intervention components. The attendee feedback provided by the conference organizer suggested the content was considered high value and useful for clinical practice. As the team moves into Project Year 4, we will continue looking at the available data for additional abstracts and manuscripts, as well as opportunities for educational engagement with clinicians and stakeholders while we wait to pursue statistical analysis on the primary project aims.

Last, the three site-PIs were able to meet in person at the NATA Conference in June. At this meeting, we discussed three primary issues: 1) setting new recruitment goals; 2) strategies to enhance retention; and 3) dissemination strategies moving forward. Overall, this was a productive meeting with actionable strategies to implement moving into Project Year 4. Following the meeting, an all-investigator meeting was held virtually in August which provided an overall project update but also relayed strategy moving forward. Based on enrollment progress, the PI set the goal to enroll a minimum of 2 subjects per month per site through the end of upcoming project year which should yield the target sample size. The PI has also requested that subjects are scheduled for follow ups at the time they complete the previous testing session instead of waiting until closer to the testing date. Additionally, subjects are to be sent monthly emails reminding them of this date and to provide any relevant updates to the study team. Lastly, the team was asked to provide additional reminders and encouragement to subjects to complete take home exercises and bolster this element of compliance.

Overall, the site-PI's have an optimistic outlook on achieving the study goals heading into the upcoming project year.

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 continued items under Major Task 2: Technical Objectives. Specifically, we will aim to get as close to 100% of the proposed total enrollment as possible. The investigators at each site have been challenged to enroll 2-3 people per month through August 2024 which would achieve the targeted enrollment. The team will also start seeing an influx of participants who will reach the 6-month, 12-month, and 24-month follow-up data collection timepoints. Over the next year, it is also anticipated that additional supporting analyses will be completed from baseline data.

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

Nothing to Report.

Changes that had a significant impact on expenditures

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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: 11/9/20, IRB #58500)
  - Continuation Review (Approved: 4/13/21)
  - Continuation Review 2 (Approved: 2/21/22)
  - Continuation Review 3 (Approved: 1/9/23)
- Naval Health Research Center (Approved: 2/4/21, IRB #58500-IR-EP)
- University of Virginia (Approved: 12/16/20, IRB# HSR200182)
- Naval Hospital Camp Pendleton (Approved by Naval Medical Center San Diego IRB: 9/16/21, IRB #935511)
- USMC HRPP (Approved: 8/6/21)
- USAMRDC ORP HRPO (Approved: 8/19/21)
- USMC Survey Office (Approved 10/18/21, USMC-NA-21007)

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

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Walsh BM, Torp DM, Hoch MC, Heimark NE, Song K, Green BS, Gribble PA, Hoch JM, Sessoms PH, Fraser JJ. Patient-reported outcomes differ between civilians and service members with chronic ankle instability. *Journal of Athletic Training*, 2023:58(6s)S-131. Accepted for presentation at: National Athletic Trainers Association Annual Meeting & Clinical Symposium. June 2023.

Song K, Green BS, Fraser JJ, Heebner NR, Heimark NE, Kosik KB, Sessoms PH, Silder A, Torp DM, Hoch MC. Static and dynamic balance differ between civilians and service members with chronic ankle instability. *Journal of Athletic Training*, 2023:58(6s)S-276. Accepted for presentation at: National Athletic Trainers Association Annual Meeting & Clinical Symposium. June 2023.

Hoch MC, Hertel J, Golden DP, Goss DD, Green B, Heimark N, Kosik K, Sessoms P, Saliba S, Silder A, Song K, Torp D, Xu J, Fraser JJ. Factors related to failed trials on a hop-to-stabilization task in service members and civilians with chronic ankle instability. Accepted for presentation at: Military Health System Research Symposium 2023. Kissimmee FL.

Journal publications.

Hoch MC, Hertel J, Gribble PA, Heebner NR, Hoch JM, Kosik KB, Long D, Silder A, Torp DM, Thompson KL, Fraser JJ. Effects of foot intensive rehabilitation (FIRE) on clinical outcomes for patients with chronic ankle instability: a randomized controlled trial protocol. *BMC Sports Science, Medicine and Rehabilitation*. 2023;15(1):1-13.

Books or other non-periodical, one-time publications.

Nothing to Report

Other publications, conference papers and presentations.

Hoch MC, Hertel J. Change is Afoot for Ankle Sprain Management. *National Athletic Trainer's Association Annual Meeting,* Indianapolis, IN. June 2023. Learning Lab.

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: CDR John J Fraser, PT, DPT, PhD
Project Role: site-PI
Researcher Identifier (e.g. ORCID ID): 0000-0001-9697-3795
Nearest person month worked: 2
Contribution to Project: Dr. Fraser is the principal investigator responsible for all research activities conducted at the Naval Health Research Center/Naval Hospital Camp Pendleton.

Name: Jay Hertel, PhD, ATC
Project Role: site-PI
Researcher Identifier (e.g. ORCID ID): 0000-0003-0680-6534
Nearest person month worked: 2
Contribution to Project: Dr. Hertel is the principal investigator responsible for all research activities conducted at the University of Virginia.

Name: Hu, Yaowen
Project Role: Co-Investigator, Medical Adviser
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Hu is overseeing activities at NHCP and serving as medical adviser.

Name: Danielle Torp, PhD, ATC
Project Role: Post-Doctoral Scholar/Interventionist
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 6
Contribution to Project: Dr. Torp has been responsible for implementing intervention protocols at the UK site and coordinating with interventionists across all sites.

Name: Nicole Heimark, MS, ATC
Project Role: Interventionist
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 4
Contribution to Project: Ms. Heimark is responsible for intervention delivery and participant recruitment at the Naval Hospital Camp Pendleton site.

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 overseeing acquisition and analysis of balance related outcome measures across all project sites.

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 responsible for providing intervention delivery at the University of Kentucky site.

Name: Katherine Thompson, PhD
Project Role: Co-Investigator/Statistician
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Thompson is contributing to elements of study design and is responsible for statistical analysis of the data.

Name: Doug Long, MS
Project Role: Study Coordinator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Mr. Long is assisting with all regulatory aspects of the project, database design/management, and electronic forms for data acquisition.

Name: Pinata Sessoms, PhD
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Sessoms is overseeing execution and regulatory approvals at NHRC.

Name: Amy Silder, PhD
Project Role: Co-Investigator
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Silder is assisting with execution and regulatory approvals at NHRC.

Name: Brian Green, PhD, PT, ATC
Project Role: Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 2
Contribution to Project: Dr. Green is responsible for data collection at the Camp Pendleton site.

Name: Kyle Kosik, PhD, ATC
Project Role: Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 2
Contribution to Project: Dr. Kosik is responsible for data collection and subject recruitment at the University of Kentucky site.

Name: Phillip Gribble, PhD, ATC
Project Role: Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Gribble is responsible for data collection and recruitment at the University of Kentucky site.

Name: Kyeongtak Song, PhD, ATC
Project Role: Post-Doctoral Scholar/Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 1
Contribution to Project: Dr. Song is responsible for data collection the University of Kentucky site.

Name: Dana Golden, MS, ATC
Project Role: Interventionist
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 6
Contribution to Project: Ms. Golden is responsible for intervention delivery and participant recruitment at the University of Virginia site.

Name: Dante Goss, MS
Project Role: Data Collection
Researcher Identifier (e.g. ORCID ID):
Nearest person month worked: 2
Contribution to Project: Mr. Goss is responsible for data collection at the University of Virginia site.

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 started 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, CDMRP
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 started 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:

Nothing to Report.