

**ORTHOPAEDIC SECTION OF THE APTA
GRANT PROGRAM
ANNUAL PROGRESS REPORT FORM**

Date:

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Name of Investigators:

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Name of Grant:

Investigating a Novel Intervention for Flexor Hallucis Longus Tendinopathy in Dancers

Award Period:

19 April 2016 – 18 April 2018

Current Year of Award Completed:

1st

1. Summary of accomplishments in the past year.

Our goals for the first year of the project were to coordinate and mobilize our team of researchers and physical therapists in Southern California and to collect pilot data on five participants in each group – healthy non-dancers, healthy dancers, and dancers with flexor hallucis longus (FHL) tendinopathy. On the first goal, we have held very successful in-person meetings with the full research and clinical team three times over the last year and produced quarterly newsletters to keep everyone up-to-date. These meetings have helped us recruit patient dancers, fine-tune our data collection procedures and our instruction of the experimental task, and led to additional collaboration with dance groups and departments in Southern California. On the data collection goal, we have recruited 5-5-4 subjects, needing just one more patient dancer with FHL tendinopathy. As expected, some dancers we brought in with likely FHL tendinopathy had additional pathologies around the ankle (most commonly Achilles tendinopathy) which excluded them from the study. We have analyzed some of these preliminary data and presented small pieces of the story at conferences over the last year. Differences between groups appear to be large, and so we are optimistic that the power analysis we will conduct after we collect the desired 5-5-5 will reveal that we only need to collect a handful more participants. In addition, we have looped in Masters and DPT students to take on small sections of project, so we are now looking more closely at the effect of FHL tendinopathy on the additional dance tasks we originally proposed solely for validation purposes. We anticipate this will help us paint a more complete picture of how these patients distribute loads during dance tasks.

2. Summary of results for posting on the Orthopaedic Section website.

This research project aims to investigate muscle coordination patterns during heel raises in dancers, specifically coordination between deep compartment lower leg musculature including the flexor hallucis longus (FHL) and the larger superficial plantarflexors. Heel raises are a common evaluation technique, and modifications could create potential treatment tools for FHL tendinopathy, an overuse injury so prevalent in dancers that it is frequently called “dancer’s tendinitis”. Despite the high prevalence, especially in female ballet dancers, there has been little research on non-surgical prevention or treatment. The design of this on-going study is cross-sectional; with three groups – healthy non-dancers, healthy dancers, and dancers with

posterior ankle pain. Participants undergo a series of clinical measures in order to evaluate involvement of the FHL tendon in posterior ankle pain. Then, researchers compare lower leg muscle activation patterns between these groups during a repetitive heel raise, a maneuver reported to contribute to the high incidence of FHL tendinopathy in dancers. In addition, a modification of this evaluation technique where the participants' toes are off the edge of a supporting block is investigated within-participants and between-groups. Analysis from our pilot participants indicates that between-conditions, hypotheses regarding pain-free dancers were confirmed as dancers decreased mean FHL peak activation in the modified relevés. Contrary to our hypotheses, dancers with FHL tendinopathy increased FHL activation in the modified heel raises. This fits with the hypothetical framework that dancers with FHL tendinopathy overuse the FHL, apparently even in conditions when it doesn't contribute to motion. As we continue to investigate additional participants, muscles, and kinematic and kinetic measures, we anticipate further explaining these differences and developing evidence-based cues to give patients during these tasks to facilitate treatment. Findings will support the further study of this task longitudinally as an evaluation tool and as an intervention for the prevention and non-surgical treatment of FHL tendinopathy.

3. List of publications and presentations based on this work.

All presentation citations listed below were based on these studies conducted with the support of this grant. No publications have been submitted at this stage in the work. These will be drafted over the next year.

Rowley KM, Shih HJ, Sutton-Traina K, and Kulig K (2017) Lower-limb muscle contributions to relevé in dancers with and without flexor hallucis longus tendinopathy and the effects of unloading the toes. *International Association for Dance Medicine and Science*, Houston, TX, USA. Podium.

Shih HJS, Trejo L, Rowley KM, Jarvis DN, Kulig K. (2017) *Investigating potential mechanisms of overuse during dance leaps in a dancer with flexor hallucis longus tendinopathy*. International Society of Biomechanics. Brisbane, Australia. Poster.

Shih HJ, Rowley KM, Kulig K. (2017) Flexor Hallucis Longus Activation in a Dancer's Modified Heel Raise – Preliminary Results. *American Physical Therapy Association Combined Sections Meeting*, San Antonio, TX, USA. Poster.

Backiev L, Rowley KM, Shih HJ, Kulig K. (2017) An initial investigation into a clinically feasible measure of medial longitudinal arch flexibility. *American Physical Therapy Association Combined Sections Meeting*, San Antonio, TX, USA. Poster.

Rowley KM,* Shih H, Jarvis DN, and Kulig K. (2016) Activation of the flexor hallucis longus in a dancer's relevé. *International Association for Dance Medicine and Science*, Hong Kong. Poster.

Shih HJ*, Rowley KM, Kulig K. (2016) Flexor hallucis longus activation and plantarflexors' muscle coordination in modified dancer's relevé – a pilot study. *Healthy Approaches in the Training of Performing Artists*, Chapman University, Los Angeles, CA, USA.

4. Updated budget.

DESCRIPTION	Budgeted Amount for Year 1	Actual Amount Spent in Year 1	Amount Remaining in Year 1 Budget	Budgeted for Year 2	Projected expenditure in Year 2
Surface Electromyography Electrodes (120/pkg)	180.00	-168.57	11.43	0.00	11.43
Fine-wire Electromyography Insertion Needles (40/pkg)	700.00	-280.00	420.00	0.00	420.00
Gloves (100/pkg)	15.00	-16.03	-1.03	0.00	-1.03
Isopropyl Alcohol (32oz.)	20.00	-9.19	10.81	0.00	10.81
Electromyography Collar Tape (500/pkg)	100.00	-88.90	11.10	0.00	11.10
Transpore Tape (12 rolls/pkg)	33.00		33.00	0.00	33.00
Kinesio Tape (1 roll/pkg)	75.00		75.00	0.00	75.00
Retroreflective Marker Maintenance Material (repairs only)	200.00		200.00	0.00	200.00
Stimulator	400.00	-185.00	215.00	0.00	215.00
Audio Speakers	100.00	-145.07	-45.07	0.00	-45.07
External Hard Drive	100.00	-62.44	37.56	0.00	37.56
Digital Encoder for Heel Raise Test	1700.00	-1736.17	-36.17	0.00	-36.17
Participant Reimbursement	2250.00	-2250.00	0.00	2250.00	2250.00
Participant Parking	300.00		300.00	300.00	600.00
Participant Snacks and Water	300.00		300.00	300.00	600.00
Physical Therapist Screening (~30min/participant, \$50/hr)	837.50	-750.00	87.50	837.50	925.00
Student Research Assistants (~100hrs/student, \$15/hr)	1500.00	-630.00	870.00	1500.00	2370.00

5. Objectives for the next year.

Our primary goal over the next month is to collect our last participant with FHL tendinopathy and run a power analysis to guide us in the rest of our collection schedule. Then over the next year, we will collect the needed subjects to power the study and analyze our primary outcome measures described in the grant proposal. Additionally during this time, we will bring back some of our initial healthy dancer subjects for re-testing to confirm test-retest reliability of these measures. We will then draft publications to share this information with the clinical and research community. We also plan to present the findings at the APTA Combined Sections Meeting in February 2018. While we are still confident the primary outcomes proposed in the grant will tell a clinically-applicable story about how to prevent and non-surgically treat this prevalent condition in dancers, we are also excited to explore secondary outcome measures that may assist in the clinical community's understanding. For instance, we have observed in our pilot subjects differences in how our three groups of participants control the toes during the toes-off heel raises – some curl them against the edge of the platform and others lift (extend them). We look forward to delving more into muscle activation on both sides of the joint, kinematics up and down the lower extremity, and center of pressure and center of mass control to try to explain these strategies and their relation to dancer training or FHL tendinopathy. Overall, we feel excited that this simple task and simple mechanical modification is yielding so many fruitful research questions, answers, and future directions, and we thank the APTA, the Orthopaedic Section, and especially the Performing Arts Special Interest Group for supporting our guided exploration.