



Academy of Orthopaedic Physical Therapy, APTA, Inc.

Grant Program

Annual Progress Report Form

Date: 4/13/2023

Name of Investigators: Patrick Corrigan, PT, DPT, PhD; Joshua Stefanik, MSPT, PhD; David Felson, MD, MPH; Tuhina Neogi, MD, PhD; Cara Lewis, PT, PhD; Michael LaValley, PhD

Name of Grant: Effect of unilateral knee pain on contralateral knee joint loads while walking: implications for the development of bilateral knee pain and osteoarthritis

Award Period: 12/1/2021 to 11/30/2023 (Initial award date – date on contract as start date)

Current Year of Award completed (circle one): 1st, 2nd, no-cost extension year (3rd)

Progress reports are due no later than 1 year plus 10 days after the initial award date. Failure to submit a timely progress report may result in the termination of your award.

1. Summary of accomplishments in the past year: In the 1st year of the award, I made progress on both research aims. For Aim 1 and 2, which involves collecting biomechanical data in individuals with unilateral knee osteoarthritis, it took much longer than expected to get the project started. Most of the delay was due to construction in the lab (e.g., wall being knocked down, treadmill going in, new motion capture system installed), purchasing lidocaine for the knee injections (there is a nation-wide shortage so it took nearly 3 months to purchase), and setting up project logistics at a new institution (e.g., finding a physician to do the injections, recruitment pathways, standard operating procedures). However, for the past 4 months, we have been completing data collections at a faster pace than originally anticipated. It may be difficult to complete data collections for all 30 participants by the end of November 2023, but we are currently very close to being able to hit that goal, having 11 people either completed or actively enrolled and completing approximately 2-3 data collections per week. Given the strict eligibility criteria, the rate limiting factor is finding people who qualify for the study. For Aim 3, which uses data from the Multicenter Osteoarthritis (MOST) Study, I have made substantial progress. I have published 1 manuscript in Arthritis Care & Research, presented preliminary analyses at 3 national conferences, and am now working on final analyses and the publication. I expect to complete this project (i.e., submit the final manuscript) by this summer. In addition to progress on the originally proposed research, I have several other notable accomplishments. In the past two months, I have been awarded 2 internal grants at Saint Louis University. Additionally, I have worked with a world-renowned team to submit an Ancillary R01 to NIH, which would leverage the renewal of the MOST Study. The next key goal of mine is to submit a K23 proposal to NIH in October. I am currently working on developing the mentorship team and training goals, but the research idea is fairly well developed and based on what I've learned from my AOPT funded work.

2. Provide a one-paragraph summary of results or abstract suitable for posting on the Academy website. I am currently investigating if biomechanical mechanisms play a role in unilateral to bilateral knee osteoarthritis progression. Specifically, I am evaluating the effect of pain on walking biomechanics in individuals with unilateral symptomatic knee osteoarthritis and exploring how walking biomechanics influence longitudinal pain and structural outcomes. I am hopeful that our findings inform medical management, walking program design, and the development of targeted physical therapy interventions that reduce pain, maximize function, and slow the progression of knee osteoarthritis.

3. Attach a list of your publications published or accepted during the past year, or currently being written. Send reprints when available. List presentations made and abstracts accepted for presentation based on this work. Indicate with an asterisk (*) those publications supported by Academy of Orthopaedic Physical Therapy funding.

Publications since award start date:

1. **Corrigan P**, Neogi T, Frey-Law L, Jafarzadeh SR, Segal N, Nevitt MC, Lewis CE, Stefanik JJ. Relation of pain sensitization to self-reported and performance-based measures of physical functioning: the Multicenter Osteoarthritis (MOST) Study. Osteoarthritis and Cartilage. Online ahead of print. doi: 10.1016/j.joca.2023.03.011
2. De Sousa AMM, Cavalcante JGT, Bottaro M, Denis César Leite Vieira, Babault N, Geremia JM, **Corrigan P**,

Silbernagel KG, Durigan JLQ, Marqueti RC. The Influence of Hip and Knee Joint Angles on Quadriceps Muscle-Tendon Unit Properties during Maximal Voluntary Isometric Contraction. *Int J Environ Res Public Health*. 2023 Feb 23;20(5):3947. doi: 10.3390/ijerph20053947.

3. Lawford BJ, Master H, Larsen JB, Bartholdy C, **Corrigan P**, Ginnerup-Nielsen E, Le C, Teoli A, Bennell KL, Metcalf B, Hinman RS, Button K, Collins NJ, Cottrell E, Henrotin Y, Skou ST, Thoma LM, Wellsandt E, White DK, Holden MA. What should a toolkit to aid the delivery of therapeutic exercise for hip and knee osteoarthritis look like? Qualitative analysis of an international survey of 318 researchers, clinicians, and consumers by the OARSI Rehabilitation Discussion Group. *Musculoskeletal Care*. <https://doi.org/10.1002/msc.1732>
- *4. **Corrigan P**, Felson DT, Lewis CL, Neogi T, LaValley MP, Gross KD, Nevitt MC, Lewis CE, Torner JC, Stefanik JJ. Relation of temporal asymmetry during walking to 2-year knee pain outcomes in those with mild-to-moderate unilateral knee pain: an exploratory analysis from the Multicenter Osteoarthritis (MOST) Study. *Arthritis Care Res (Hoboken)*. <https://doi.org/10.1002/acr.25050>
5. **Corrigan P**, Hornsby S, Pohlig RT, Willy RW, Cortes DH, Silbernagel KG. Tendon loading in runners with Achilles tendinopathy: relations to pain, structure, and function during return-to-sport. *Scand J Med Sci Sports*. 2022; 32(8):1201-1212. doi: 10.1111/sms.14178.

In addition to these publications, I have 3 middle-authored publications currently under review, 2 senior-authored publications nearing submission, and 1 first-authored publication (Aim 3 of my AOPT grant) that I expect to submit this summer.

Abstract Presentations since award start date:

1. James KA, **Corrigan P**, Huang CH, Lanois C, Davis IS, Stefanik JJ. Effects of gait retraining on impact loading and pain in adults with knee osteoarthritis. American College of Sports Medicine Annual Meeting. Thematic Poster Presentation.
2. James KA, Neogi T, Felson DT, **Corrigan P**, CL Lewis, Davis IS, Bacon K, Torner JC, Lewis CE, Nevitt MC, Stefanik JJ. Relation of walking cadence to changes in knee pain: The Multicenter Osteoarthritis Study. Osteoarthritis Research Society International World Congress. Poster Presentation.
- *3. **Corrigan P**, Lewis CL, Costello KE, Guermazi A, Roemer FW, Kumar D, Felson DT, Bacon K, Neogi T, LaValley MP, Nevitt MC, Lewis CE, Torner JC, Stefanik JJ. Asymmetric ground reaction forces while walking are not associated with unilateral to bilateral knee osteoarthritis progression: the Multicenter Osteoarthritis Study. Osteoarthritis Research Society International World Congress. Poster Presentation.
4. Lanois C, **Corrigan P**, Harkey M, Stefanik JJ. Validation of Automated Program to Segment Femoral Articular Cartilage with Ultrasonography. Osteoarthritis Research Society International World Congress. Poster Presentation.
5. Bacon KL, Felson DT, Jafarzadeh SR, Kolachalama VB, Hausdorff JM, Gazit E, Stefanik JJ, **Corrigan P**, Segal NA, Lewis CE, Nevitt MC, Kumar D. Gait alterations associated with worsening physical function over 2 years: A machine-learning approach in the Multicenter Osteoarthritis (MOST) Study. Osteoarthritis Research Society International World Congress. Poster Presentation.
6. Huang CH, James KA, **Corrigan P**, Lanois C, Stefanik JJ. Joint Coordination Patterns are Associated with Joint loading in Persons with Knee Osteoarthritis. Osteoarthritis Research Society International World Congress. Poster Presentation.
- *7. Price S, Stefanik JJ, Silbernagel KG, **Corrigan P**. Effect of walking asymmetry on biomechanical compensations: implications for single to multi-joint osteoarthritis progression. Osteoarthritis Research Society International World Congress. Poster Presentation.
8. Huang CH, **Corrigan P**, James K, Lanois C, Stefanik JJ. Hip-knee Joint Coordination Patterns Are Associated with Pain Severity in Persons With Knee Osteoarthritis. Orthopedic Research Society Annual Meeting. Poster Presentation.
9. Hanselman A, Seymore KD, Pohlig RT, Silbernagel KG, **Corrigan P**. Relation of Tendon Forces to Pain throughout a 30-Minute Run in Runners with Achilles Tendinopathy. American Physical Therapy Association's Combined Sections Meeting. Platform Presentation.
- *10. **Corrigan P**, Lewis CL, Costello KE, Guermazi A, Roemer FW, Kumar D, Felson DT, Bacon K, Neogi T, LaValley MP, Nevitt MC, Lewis CE, Torner JC, Stefanik JJ. Asymmetric Walking Does Not Explain Unilateral to Bilateral Knee Osteoarthritis Progression: The Multicenter Osteoarthritis (MOST) Study. American Physical Therapy Association's Combined Sections Meeting. Platform Presentation.
11. James KA, **Corrigan P**, Lanois C, Huang CH, Davis IS, Stefanik JJ. Tibial Acceleration During Walking Relates to Pain and Impact Loading in Persons with Knee Osteoarthritis. American Physical Therapy Association's Combined Sections Meeting. Poster Presentation.
- *12. **Corrigan P**, Lewis CL, Costello KE, Guermazi A, Roemer FW, Kumar D, Felson DT, Bacon K, Neogi T, LaValley MP, Nevitt MC, Lewis CE, Torner JC, Stefanik JJ. Three-dimensional Ground Reaction Force Symmetry Metrics Largely Fail to Explain Cartilage Worsening in the Contralateral Knee in Persons with Unilateral Knee Osteoarthritis: The Multicenter Osteoarthritis Study. American College of Rheumatology's Convergence Meeting. Platform Presentation.
13. Bacon K, Felson DT, Jafarzadeh SR, Kolachalama V, Hausdorff J, Gazit E, Stefanik JJ, **Corrigan P**, Segal NA, Lewis CE, Nevitt MC, Kumar D. Gait alterations associated with worsening physical function over 2 years: A machine-learning approach in the Multicenter Osteoarthritis (MOST) Study. American College of Rheumatology's Convergence Meeting. Poster Presentation and Ignite Talk.

14. James KA, **Corrigan P**, Lanois C, Huang CH, Davis IS, Stefanik JJ. Association of Tibial Acceleration During Walking to Knee Pain and Loading in Adults with Knee Osteoarthritis. American College of Rheumatology's Convergence Meeting. Poster Presentation.
15. Seymore KD, **Corrigan P**, Sigurðsson HB, Silbernagel KG. The MileStone Pod and motion capture produce comparable spatiotemporal parameters in runners with and without Achilles tendinopathy. North American Congress of Biomechanics. Poster Presentation.
16. **Corrigan P**, Felson DT, Neogi T, Lewis CL, Torner JC, Nevitt MC, Lewis CE, Stefanik JJ. Foot or ankle pain as a risk factor for worsening knee pain: the MOST study. American Physical Therapy Association's Combined Section Meeting. Platform Presentation.

In addition to these abstracts, I have 1 senior-authored abstract under review for the American Society of Biomechanics annual conference and plan to submit several abstracts in the next 3 months to the annual meetings for the American College of Rheumatology and the American Physical Therapy Association.

4. Provide a budget, using the original approved budget. Indicate total funds spent to date per major categories. If there was $\geq 25\%$ deviation (greater or less spent) of use of funds for any of the budget category, please BRIEFLY indicate the rationale. (See example below)

EXPENSE CATEGORY	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
Personnel	10,105	0	10,105	10,105	20,210
Supplies	3,800	2,745.84	1,054.16	400	1,454.16
Participant Costs	3,130	30	3100	1565	4,665
Other	0	0	0	895	895
TOTAL	17,035	2775.84	14259.16	12,965	30,000

Personnel: Currently, I have not spent funds on research assistants. I originally budgeted for \$10,105 per year to partially support my PhD student. However, my Dean's Office awarded my PhD student a fully-funded graduate assistantship. I am currently recruiting another PhD student to start in August 2023. If successful at filling the position, funds will be used to partially support the new PhD student who would be involved in data collections, processing, and dissemination of findings. If unsuccessful at filling the position, I will work with the foundation to re-budget to support a portion of my salary. In either situation, I am also expecting to support other research assistants (non-PhD students) during the summer and fall as data collections are now being completed at a rapid pace.

Supplies: Some of the supplies that were budgeted were cheaper than expected. Specifically, the medication used for the injections as well as the supplies for the injections were substantially cheaper than the budgeted amount. We are currently deciding on how to re-budget funds from this category and will be in touch with the foundation shortly.

Participant Costs: Because of the delays described above, data collections did not begin for Aims 1 & 2 until January 2023. However, we still expect to spend the originally budgeted amount because advertisements are ongoing and the same number of participants are being recruited.

5. Objectives for the next year:

- Complete data collections for Aims 1 and 2
- Submit preliminary findings for Aims 1 and 2 as abstracts to national meetings (e.g., American Physical Therapy Association, Orthopedic Research Society, American College of Rheumatology, and Osteoarthritis Research Society International, American Society of Biomechanics)
- Complete final analyses and publish Aim 3 findings

Your Signature

4/13/2023

Date

Return to:

Tara Fredrickson, Assistant Executive Director
Academy of Orthopaedic Physical Therapy, APTA, Inc.
2920 East Avenue South, Suite 200
La Crosse, WI 54601-7202
tfred@orthopt.org