Academy of Orthopaedic Physical Therapy, APTA, Inc.
Grant Program
Annual Progress Report Form

Date: 9/2/2020

Name of Investigators: Jacob J. Capin, PT, DPT, PhD

Name of Grant: Career Development Award

Award Period: 9/1/19 to 8/31/20 (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: See attached

2. Provide a one-paragraph summary of results or abstract suitable for posting on the Academy website. See attached

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. See attached.

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

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
TOTAL					

5. Objectives for the next year: See attached

Jacob J. Capin
Your Signature

9/2/2020
Date

Return to:

Tara Fredrickson, Executive Associate
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1. SUMMARY OF ACCOMPLISHMENTS IN THE PAST YEAR

1.A. Progress toward becoming an independent investigator

I have made significant progress toward becoming an independent investigator over Year 1 of the award. I completed my PhD in biomechanics and movement sciences shortly before the award started and began my postdoctoral fellowship in the RESTORE lab at the University of Colorado on September 1, 2019. Over the past year, I have secured grants (see 1.B.2), mentored junior trainees, engaged in career development opportunities (e.g., workshops, seminars), and immersed myself fully in the many ongoing clinicals trials and research endeavors of the RESTORE team. I have collected data for the proposed research (see 1.D), overseen the analyses of these data, and helped manage lab personnel executing our ongoing research. I have mentored PhD students to apply for grants and secure extramural funding and I am serving on the mentoring committee for the Capstone project of a Master's of Human Anatomy student. I have also begun applying and interviewing for a tenure-track faculty position to begin following completion of my postdoctoral fellowship. I have made significant progress in the main objectives for my postdoctoral training as described in my initial application; these objectives include 6 main areas: clinical trials, musculoskeletal imaging, lab management, scientific writing, biostatistics, and behavioral health. These myriad experiences and the year ahead will prepare me to be an independent investigator.

1.B. Publications and grants

1.B.1. Publications: Due to restrictions on publishing secondary analyses of clinical trials, I will be unable to publish the aims of the AOPT Career Development Grant until after the primary aims of the clinical trial from which the AOPT aims are derived is published (see 1.C. for details). While I have not yet published or submitted any manuscripts specifically related to the proposed aims, I have developed ancillary products currently in revision, in review, or in progress on patients after total knee replacement. I have one manuscript in revision, one primary author manuscript in review, and two manuscripts in progress (one primary author). I have three abstracts that are in review. See 3. Publications and Presentations for details.

1.B.2. Grants: I have secured as Principal Investigator (PI) two grants including a Veterans Affairs Advanced Geriatrics Fellowship and a National Institutes of Health Ruth L. Kirschstein National Research Service Award Fellowship (NIA F32). I have assisted the RESTORE team to write several major grants over the past year. I have helped PhD students write grants and earn fellowships from the American College of Rheumatology.

1.C. Progress on research project

The purpose of the proposed research is to leverage data from the parent MOVE clinical trial (R01 AG056585) to answer impactful secondary questions regarding contralateral knee osteoarthritis (OA) and movement asymmetries in patients after total knee arthroplasty (TKA). Specifically, the aims are to:

AIM 1: *Determine if pre-operative movement asymmetries (as surrogates for longstanding movement asymmetries) are associated with early signs of contralateral knee OA severity.*
AIM 2: *Determine the baseline factors that are associated with greater concurrent movement asymmetry.*
EXPLORATORY AIM: *Describe OA progression using baseline to 2-year changes in quantitative magnetic resonance imaging (MRI) measures (cartilage thickness, T_2, T_{1rho}) among those with asymmetrical and symmetrical movement patterns during walking 6 months after TKA.*

I am proficient in collecting all biomechanical and clinical measures and oversee biomechanical data analysis. I also assist with MRI collections. Our primary challenge has been patient recruitment, which was paused for nearly 4 months due to COVID-19 but resumed in July 2020. We currently have 70 of 150 planned patients enrolled. Our retention, however, is excellent (over 90%) and only 120 participants are needed to complete the trial. Aims proposed in this award cannot be published until after the primary findings of the parent clinical trial are published, which will likely occur in 2-3 more years. My biggest opportunity has been to leverage the AOPT award to create a subcontract (see revised budget) with collaborators at the University of California San Francisco (UCSF) who are on the cutting edge of MRI analyses. Our UCSF collaborators will analyze the images using an automated approach that will provide not only the regional assessments of cartilage proposed in the Aims but also advanced parametric mapping (Future Direction #5). Please note that while we have negotiated the agreement with our UCSF collaborators, the subcontract is still being processed, thus there is a surplus of funds from Year 1 that we plan to use in Year 2 (see 4. Budget for details). While the timeline of the research products is delayed, ultimately this award will translate into more products and greater impact.

During the 'downtime' imposed by the recruitment lull, I wrote an invited perspective manuscript on rehabilitation of patients after TKA that we submitted to the *Journal of Orthopaedic Research*. I have also been developing a collaborative research effort focused on outcomes and variation in practice after implementing a

care process guideline for TKA rehabilitation. Collaborating with our colleagues at Intermountain Healthcare, I was instrumental in getting two abstracts prepared in time for CSM abstract submission and have been leading the charge to develop the manuscripts, which we plan to submit this fall. See 3.A. for details.

I also identified several areas to help our lab grow. I developed a technical manual/protocol for muscle strength and activation testing to ensure all testers across studies were using the same approach. I helped establish a study evaluating the effect of therapeutic arthrocentesis at a local hospital, setting up the equipment and training the staff to do strength, activation, and functional patients for patients with OA-related knee swelling. I worked with our biomechanics processors to refine our code to solve challenges. I even pitched in to help cover weekend shifts for increasing physical activity in Veterans in our skilled nursing facility research study, thereby helping my team and gaining exposure to physical activity and behavioral change as noted in my postdoctoral training goals. In summary, I have gained new skills and enhanced existing strengths. I am confident that I will be well prepared for an upcoming faculty position as an independent researcher.

2. ONE-PARAGRAPH SUMMARY OF RESULTS OR ABSTRACT SUITABLE FOR POSTING ON THE ACADEMY WEBSITE

The purpose of the proposed research supported by the AOPT Career Development Grant is to leverage data from the parent MOVE clinical trial (R01 AG056585) to answer impactful secondary questions regarding contralateral knee osteoarthritis (OA) and movement asymmetries in patients after total knee arthroplasty (TKA). Specifically, the aims are to 1) determine if pre-operative movement asymmetries (as surrogates for longstanding movement asymmetries) are associated with early signs of contralateral knee OA severity; 2) determine the baseline factors associated with greater concurrent movement asymmetry; and 3) (exploratory) describe OA progression using baseline to 2-year changes in quantitative magnetic resonance imaging (MRI) measures (cartilage thickness, T2, T1rho) among those with asymmetrical and symmetrical movement patterns during walking 6 months after TKA. This past year has brought forth many challenges yet also opportunities for growth. Recruitment was paused for nearly 4 months due to COVID-19 but resumed in July 2020. We currently have 70 patients enrolled (120 needed to complete) and our retention is excellent (>90%). In addition to collecting and processing data, one great opportunity has been to leverage the AOPT award to create a subcontract with collaborators at the University of California San Francisco (UCSF) who are on the cutting edge of MRI analyses. Our UCSF collaborators will analyze the images using an automated approach that will generate not only the regional assessments of cartilage proposed in the Aims but also advanced parametric mapping of quantitative MRI variables, identifying specific areas of cartilage degradation (an analysis proposed in the original AOPT Career Development Grant submission as a future direction). While the aims of this project cannot be published or presented until the primary findings of the parent clinical trial are published, ultimately the findings of this AOPT Career Development Award will translate into more products and greater impact. During the pause in recruitment, Dr. Capin worked on several ancillary products including two manuscripts now in review and two abstracts submitted to CSM (manuscripts for these works are in preparation), all of which are supported in part by the AOPT. He also assisted the RESTORE team to write major grants, helped mentor PhD students to obtain funding from extramural sources, and attended workshops and seminars, facilitating his career development training objectives.

3. PUBLICATIONS AND PRESENTATIONS

**Asterisk indicates manuscripts supported in part by the Academy of Orthopaedic Physical Therapy funding.*

3.A. Manuscripts in progress or in review

1. *Christiansen JC, **Capin JJ**, Hinrichs L, Aljehani M, Steves-Lapsley J, Zeni JA. Gait mechanics are influenced by quadriceps strength, age and sex after total knee arthroplasty. *Journal of Orthopaedic Research.* In revision.
2. ***Capin JJ**, Bade MJ, Jennings JM, Snyder-Mackler L, Stevens-Lapsley J. Total Knee Arthroplasty Assessments Should Include Strength and Performance-Based Functional Tests to Complement Range-of-Motion and Patient-Reported Outcome Measures. *Journal of Orthopaedic Research.* In review.
3. ***Capin JJ**, Minick K, Stevens-Lapsley J, Woodfield D, Snow G, Dibblee P, Brennan G, Hunter SJ. Reduced variation following a care guideline implementation; Analysis of 11,120 patients after total knee arthroplasty. *Physical Therapy.* In preparation.

4. *Hunter SJ, Minick K, Snow G, **Capin JJ**, Stevens-Lapsley J, Woodfield D, Van der Wees P, Dibblee P, Brennan G. Improved outcomes following a care process implementation; analysis of 11,120 patients after total knee arthroplasty. *Physical Therapy.* In preparation.

3.B. Publications from the past year

1. Ito N, **Capin JJ**, Arhos E, Khandha A, Buchanan TS, Snyder-Mackler L. Sex and Mechanism of Injury Influence Knee Joint Loading Symmetry During Gait 6 Months after ACLR. *Journal of Orthopaedic Research.* 2020 Aug 6; doi: 10.1002/jor.24822. PubMed PMID: 32761919; NIHMSID: NIHMS1618992.
2. Knobel R, Ito N, Arhos E, **Capin JJ**, Buchanan TS, Snyder-Mackler L. Patients Walking Faster After Anterior Cruciate Ligament Reconstructin Have More Gait Asymmetry. *The International Journal of Sports Physical Therapy.* 2020; Accepted on July 24, 2020.
3. Johnson JL, **Capin JJ,** Arundale AJH, Smith AH, Zarzycki R, Snyder-Mackler, L. Secondary injury prevention program may decrease contralateral ACL injuries in female athletes: 2-year injury rates in the ACL-SPORTS randomized control trial. *Journal of Orthopaedic and Sports Physical Therapy.* 2020 Aug 1;1-28. doi: 10.2519/jospt.2020.9407. PubMed PMID: 32741328; NIHMSID: 1619233.
4. Arhos E, **Capin JJ**, Ito N, Snyder-Mackler L. Functional Measures Do Not Differ in Late Stage Rehabilitation After Anterior Cruciate Ligament Reconstruction According to Mechanism of Injury. *The International Journal of Sports Physical Therapy*. 2020; Accepted on February 19, 2020.
5. Wellsandt E, Khandha A, **Capin J**, Buchanan T, Snyder-Mackler L. Operative and Non-Operative Management of Anterior Cruciate Ligament Injury: Differences in Gait Biomechanics at 5 Years. *Journal of Orthopaedic Research*. 2020; E-published on Mar 11, 2020; doi: 10.1002/jor.24652. PubMed PMID: 32159239; NIHMSID: NIHMS1576827.
6. **Capin JJ**, Williams JR, Neal K, Khandha A, Durkee L, Ito N, Stefanik JJ, Snyder-Mackler L, Buchanan TS. Slower walking speed is related to early femoral trochlear cartilage degradation after ACL reconstruction. *Journal of Orthopaedic Research.* 2020 Mar;38(3):645-652. doi: 10.1002/jor.24503. PMID: 31710115; PMCID: PMC7028512.
7. Smith AH, **Capin JJ,** Zarzycki R, Snyder-Mackler, L. Athletes With Bone-Patellar Tendon Bone Autograft for ACL Reconstruction Were Months Slower to Meet Rehabilitation Milestones and Return to Sport Criteria Than Athletes With Hamstring Tendon Autograft or Soft Tissue Allograft: Secondary Analysis From the ACL-SPORTS Trial. *Journal of Orthopaedic and Sports Physical Therapy.* 2020 May;50(5):259-266. doi: 10.2519/jospt.2020.9111. PMID: 31775553; PMCID: PMC7196003.
8. **Capin JJ**, Snyder-Mackler L, Risberg MA, Grindem H. Keep Calm and Carry On Testing—A Substantive Reanalysis and Critique of "What is the Evidence for and Validity of Return-to-Sport Testing after Anterior Cruciate Ligament Reconstruction Surgery? A Systematic Review and Meta-Analysis." *British Journal of Sports Medicine*. 2019 Dec;53(23):1444-1446. doi: 10.1136/bjsports-2019-100906. PMID: 31289039; PMCID: PMC6858490.
9. **Capin JJ,** Khandha A, Buchanan TS, Snyder-Mackler L. Partial medial meniscectomy leads to altered walking mechanics two years after anterior cruciate ligament reconstruction: Meniscal repair does not. *Gait & Posture.* 2019 Oct;74:87-93. doi: 10.1016/j.gaitpost.2019.08.017. PMID: 31491565; PMCID: PMC6790293.

3.C. Presentations based on this work

Not applicable. See 1.C. for details.

4. BUDGET

Explanation: Please note that a revised budget was approved in June 2020. The table below reflects the revised budget. As noted above (1.C.), we have now allocated funds to cover the costs of the proposed (regional) quantitative MRI analyses plus additional parametric mapping of the quantitative MRI data. The parametric mapping ('advanced MRI analyses') will provide more nuanced and detailed analyses that cannot be done manually and thus require an automated approach. The automated approach is computationally demanding, and we are not equipped to perform these advanced MRI analyses. Our collaborators at UCSF, however, are leaders in the field of advanced musculoskeletal imaging and are equipped to perform these advanced MRI analyses. We have created an agreement with UCSF but the subcontract to perform the advanced MRI analyses is currently in process; hence, we have not yet spent the amount budgeted in Year 1 for the MRI analyses. We anticipate spending the remaining amount of the Year 1 award and the entire Year 2 award on the advanced MRI analyses. See revised budget for details.

Expense Category	Budgeted Amount Year 1 ($)	Amount Spent in Year 1	Amount Remaining Year 1 Budget	Budgeted Amount Year 2 ($)	Projected Expenditure Year 2
Salary Support	$9,600	$10,690.15	($1,090.15)	-	-
Conference Travel	$400	$468.16	($68.16)	-	-
MRI Analyses	$15,000	-	$15,000	$25,000	$38,841.69
TOTAL:	$25,000	$11,158.31	$13,841.69	$25,000	$38,841.69

5. OBJECTIVES FOR YEAR 2

1. Research Project:
    a. Recruit and enroll at least 40 more participants
    b. Collect and oversee processing of biomechanical data for at least 40 more participants
    c. Formalize MRI analysis subcontract with UCSF
    d. Collect MRI data on at least 40 more participants
    e. Draft introduction and methods sections for manuscripts of the proposed AOPT Aims so that when the primary analyses of the parent (MOVE) trial are published, we may rapidly publish the findings from the AOPT Aims
2. Career Development:
    a. Attend at least 8 workshops or seminars (as described in original grant)
    b. Continue to participate in weekly RESTORE team meetings, individual mentor meetings, lab management responsibilities, and mentorship of junior trainees
    c. Secure a research faculty position