

1. SUMMARY OF MAJOR ACCOMPLISHMENTS

1.A. Postdoctoral Training Objectives of Independent Investigator

I am grateful for funding from the Academy of Orthopaedic Physical Therapy (AOPT) to support our research, facilitate my postdoctoral training objectives, and advance my professional career. Over the course of the two-year award, I have secured grants (F32, DP5), presented and published research, engaged in career development opportunities (e.g., mentor meetings, lab meetings, workshops, seminars, conferences), mentored junior trainees, and immersed myself fully in the many ongoing clinical trials and research endeavors of the RESTORE team. These accomplishments and others were facilitated by outstanding mentorship including regular mentor meetings and other exceptional training opportunities.

During the award period, I collected data for the AOPT research, helped oversee the analyses of these data, and helped manage lab personnel executing our ongoing research. I mentored PhD students to apply for grants and secure extramural funding and I served as a committee member (mentor) for the Capstone project of a Master's of Human Anatomy student. I worked with and learned from biostatisticians to expand my knowledge of statistics and to develop research products. I also gained exposure to behavioral health concepts by serving as the primary interventionist on a biobehaviorally informed clinical trial investigating telerehabilitation for COVID-19 survivors. As noted in the Year 1 Progress Report, we developed an exciting collaboration with University of California San Francisco researchers on the cutting edge of magnetic resonance imaging (MRI) analyses and that collaboration will ultimately yield greater and more impactful research products. In short, I accomplished my postdoctoral training objectives and am well prepared for the next stage of my career.

Training Objective	Status
1. Clinical Trials: Engage in all aspects of clinical trials development and execution, including conception, design, implementation, fidelity, analysis, abstract and manuscript preparation, and presentation	Met
2. Musculoskeletal Imaging: Gain skills in quantitative and semi-quantitative MRI	Established collaboration with researchers at UCSF (see below)
3. Lab Management: Learn effective lab management and mentor junior lab members	Met
4. Scientific Writing: Enhance my scientific writing of abstracts, manuscripts, and grants	Met
5. Biostatistics: Expand my biostatistics knowledge	Met
6. Behavioral Health: Gain exposure to behavior change, physical activity, and nutrition concepts	Met

1.B. Evidence of Transition to Being an Independent Investigator

On September 27, 2021, I began a tenure-track position as Assistant Professor of Physical Therapy at Marquette University, where I direct the Life After Sport Trajectories (LAST) Laboratory and will teach kinesiology to Doctor of Physical Therapy

students. I received an NIH Director's Early Independence Award for the project, 'Life After Sport: Prior Injury and Sedentary Behavior as Mechanisms of Later Poor Health' (DP5-OD031833). The DP5 award is a 5-year, \$1.9 million grant awarded through the NIH Common Fund's High Risk High Reward Research program. Only 13 DP5 grants were awarded in 2021, and I am the first physical therapist to receive the recognition. Funding from the AOPT not only supported my postdoctoral training and research but also helped make me a competitive applicant for faculty positions and the DP5 grant.

1.C. Publications and Grants

1.C.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 several ancillary products on patients after total knee replacement. One manuscript has been published in the *Journal of Orthopaedic Research*, three manuscripts are in revision, and several other products are forthcoming. I also contributed to three related presentations, including a platform presentation I gave as first author, at APTA's Combined Sections Meeting 2021. See 3. Publications and Presentations for details.

1.C.2. Grants: I secured as Principal Investigator (PI) two postdoctoral fellowship grants including a Veterans Affairs Advanced Geriatrics Fellowship and a National Institutes of Health Ruth L. Kirschstein National Research Service Award Fellowship (F32-AG066274). I assisted the RESTORE team in writing several major grants including an NIH-funded study (R01-AG054366) on 'Predictors of Recovery and the App-Facilitated Tele-Rehabilitation (AFTER) Program for COVID Survivors.' I helped PhD students write grants and earn fellowships from the American College of Rheumatology. As noted above, I also received an NIH Director's Early Independence Award (DP5-OD031833) to fund my research as a junior faculty member at Marquette University.

1.D. Progress on the Research Project

The purpose of the AOPT 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 , $T_{1\rho}$) among those with asymmetrical and symmetrical movement patterns during walking 6 months after TKA.*

I am proficient in collecting and analyzing all biomechanical and clinical measures. I also assisted with MRI data collections. Our primary challenge has been patient

recruitment, which was paused for nearly four months due to COVID-19 and has occurred in lower numbers in the subsequent months. Nevertheless, we currently have 101 of 150 planned patients enrolled. Further, our retention 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 within one to two years.

My biggest opportunity has been to leverage the AOPT award to create a subcontract with collaborators at the University of California San Francisco (UCSF) on the cutting edge of MRI analyses. Our UCSF collaborators are analyzing 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). While the timeline of the research products is delayed, ultimately this award will translate into more products and greater impact.

During my postdoctoral fellowship, I also engaged in several other ancillary projects and research opportunities, I wrote a perspective manuscript on rehabilitation of patients after TKA (in revision). I also helped develop 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, we presented two platform presentations for APTA's 2021 Combined Sections Meeting and are currently revising the two manuscripts for resubmission. I also helped develop the COVID AFTER study, which we recently completed through the primary endpoint and are in the process of developing research products. See section 3 (below) for details.

1.5. Conclusion

In summary, my postdoctoral fellowship – funded in part by the AOPT Career Development Grant – yielded a robust and meaningful training experience. I accomplished the training objectives set forth in the initial application and secured an independent, tenure-track faculty position at Marquette University and major extramural funding. I am incredibly grateful for the training experience and the support of AOPT and excited for the opportunity ahead.

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

The purpose of the Academy of Orthopaedic Physical Therapy (AOPT) Career Development Grant was to determine how factors including movement patterns contribute to contralateral knee osteoarthritis (OA) following unilateral total knee arthroplasty (TKA) and to provide the fellow a comprehensive postdoctoral training experience. While recruitment for the primary aims was delayed due to COVID-related pauses and reductions in joint replacement surgeries, there were significant developments and accomplishments over the course of the two-year award. First, Dr. Capin and his postdoctoral mentor, Dr. Jennifer Stevens-Lapsley, leveraged the AOPT funds to establish a subcontract with University of California San Francisco (UCSF) collaborators on the cutting edge of MRI analyses. The UCSF collaborators are analyzing the images using an automated approach that will generate not only regional assessments of cartilage (per the specific aims) but also advanced parametric mapping of quantitative MRI variables, identifying specific areas of cartilage degradation. Although the aims of this project cannot be published or presented until the primary findings of the parent clinical trial (R01-AG056585) are published, ultimately the findings of this AOPT grant will translate into more products and greater impact. Second, Dr. Capin worked on several ancillary research projects. Collaborations with clinicians and researchers at Intermountain Healthcare found an improvement in outcomes and reduction in variation after implementing a care process guideline for TKA rehabilitation; findings were presented at CSM 2021 and the manuscripts are in revision. Dr. Capin also helped Dr. Stevens-Lapsley, Dr. Kristine Erlandson, and colleagues secure NIH funding (R01-AG054366) for a study on the App-Facilitated Tele-Rehabilitation (AFTER) Program for COVID Survivors. Jacob gained experience in motivational interviewing and biobehavioral principles while serving as the primary interventionist on the AFTER study; as of fall 2021, results of the trial are being analyzed. Finally, Dr. Capin benefited from a rich and diverse postdoctoral training experience, supported in part by the AOPT. In September 2021, Dr. Capin began a tenure-track faculty position as Assistant Professor of Physical Therapy at Marquette University, where he directs the Life After Sport Trajectories (LAST) Laboratory and teaches kinesiology to Doctor of Physical Therapy students. He was also awarded an NIH Director's Early Independence Award for the project, 'Life After Sport: Prior Injury and Sedentary Behavior as Mechanisms of Later Poor Health' (DP5OD031833).

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. ***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. *Physical Therapy*. In Revision.
2. ***Capin JJ**, Minick K, Stevens-Lapsley J, Snow G, Woodfield D, Dibblee P, Brennan G, Hunter SJ. Reduced variation following a care guideline implementation after total knee arthroplasty. In Revision
3. *Minick K, Hunter SJ, **Capin JJ**, Stevens-Lapsley J, Snow G, Woodfield D, Dibblee P, Brennan G. Improved outcomes following a care process implementation after total knee arthroplasty. In Revision.
4. *Jolley SE, Nordon-Craft A, Wilson M, Ridgeway K, Rauzi MR, **Capin JJ**, Heery LM, Stevens-Lapsley J, Erlandson KM. Disparities in allocation of inpatient physical and occupational therapy services for patients with COVID19. *Journal of Hospital Medicine*. In Revision.
5. ***Capin JJ**, Wilson MP, Hare K, Vempati S, Little CE, McGregor D, Castillo-Mancilla J, Stevens-Lapsley J, Jolley SE, Erlandson KE. Prospective telehealth analysis of functional performance, frailty, quality of life, and mental health after COVID-19 hospitalization. *BMC Geriatrics*. In Review.
6. *As noted above, the manuscripts fulfilling the primary aims of the AOPT Career Development Grant will be developed and submitted after the primary aims of the parent project are completed.

3.B. Publications from the past year

1. Zarzycki R, Arhos EK, Failla M, **Capin JJ**, Smith AH, Snyder-Mackler L. Positive psychological response to the ACL-SPORTS training program yields better self-reported function two years after ACL reconstruction compared to non-responders. *American Journal of Sports Medicine*. 2021 Oct 8:3635465211045388. doi: 10.1177/03635465211045388. [Epub ahead of print] PubMed PMID: 34623939
2. *Christensen JC, **Capin JJ**, Hinrichs L, Aljehani M, Stevens-Lapsley J, Zeni J. Gait mechanics are influenced by quadriceps strength, age and sex after total knee arthroplasty. *Journal of Orthopaedic Research*. 2021 Jul;39(7):1523-1532. doi: 10.1002/jor.24878. PMID: 33034899.
3. 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*. 2021 May;39(5):1123-1132. doi: 10.1002/jor.24822. PMID: 32761919; PMCID: PMC7864984.
4. Williams JR, Neal K, Fayyadh AB, Lennon K, **Capin JJ**, Khandha A, Manal K, Potter H, Snyder-Mackler L, Buchanan TS. Knee Cartilage T2 Relaxation Times 3 Months after ACL Reconstruction Are Associated with Knee Gait Variables Linked

- to Knee Osteoarthritis. *Journal of Orthopaedic Research*. 2021 Mar 30; doi: 10.1002/jor.25043. PubMed PMID: 33783867.
5. Arhos E, **Capin JJ**, Buchanan TS, Snyder-Mackler L. Quadriceps Strength Symmetry Does Not Modify Gait Mechanics After ACL Reconstruction, Rehabilitation, and Return-to-Sport Training. *American Journal of Sports Medicine*. 2021 Feb;49(2):417-425. doi: 10.1177/0363546520980079. PMID: 33373534; PMCID: PMC7863565.
 6. Knobel R, Ito N, Arhos E, **Capin JJ**, Buchanan TS, Snyder-Mackler L. Patients Walking Faster After Anterior Cruciate Ligament Reconstruction Have More Gait Asymmetry. *The International Journal of Sports Physical Therapy*. 2021 Feb 1;16(1):169-176. PubMed PMID: 33604147; PubMed Central PMCID: PMC7872452.
 7. 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 Dec;38(12):2675-2684. doi: 10.1002/jor.24652. PMID: 32159239; NIHMSID:NIHMS1576827.
 8. 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; Oct;15(5):744-754. doi: 10.26603/ijsp20200744. PMID: 33110693.
 9. 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 Sep;50(9):523-530. doi: 10.2519/jospt.2020.9407. PMID: 32741328; PMCID: PMC7484246.

3.C. Presentations based on this work

1. **Capin JJ**, Minick K, Stevens-Lapsley J, Van der Wees PJ, Woodfield D, Snow G, Dibblee P, Brennan GP, Hunter SJ. Reduced Variation Following a Care Guideline Implementation; Analysis of 11,120 Patients after Total Knee Arthroplasty. Platform Presentation. *Combined Sections Meeting of the American Physical Therapy Association (CSM 2021)*: Virtual Conference, February 24-27, 2021.
2. Hunter SJ, Minick K, Snow G, **Capin JJ**, Stevens-Lapsley J, Woodfield D, Van der Wees PJ, Dibblee P, Brennan GP. Improved Outcomes Following a Care Guideline Implementation; Analysis of 11,120 Patients after Total Knee Arthroplasty. Platform Presentation. *Combined Sections Meeting of the American Physical Therapy Association (CSM 2021)*: Virtual Conference, February 24-27, 2021.
3. Hinrichs LA, Christensen JC, **Capin JJ**, Aljehani MS, Zeni J, Stevens-Lapsley J. Gait Mechanics are Influenced by Quadriceps Strength, Age and Sex after Total Knee Arthroplasty. Poster Presentation. *Combined Sections Meeting of the American Physical Therapy Association (CSM 2021)*: Virtual Conference, February 24-27, 2021.

4. BUDGET

Explanation: Please note that a revised budget was approved in June 2020 and affirmed during the Year 1 Progress Report, and the expenditures are consistent with that budget.

Expense Category	Budgeted Amount Year 1 (\$)	Amount Spent in Year 1	Remaining Year 1 Budget	Budgeted Amount Year 2 (\$)	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