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Physical Therapy  
Department

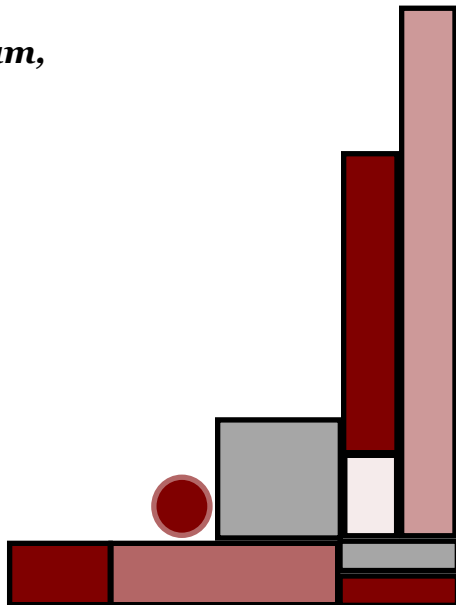
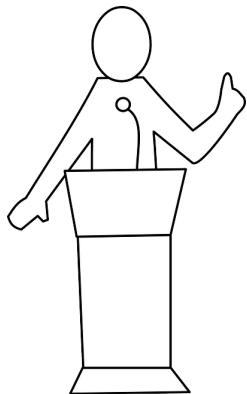
January 12, 2017

# Clinical Practice: Critical Inquiry



**Poster Session**  
*Great Room, University Commons*

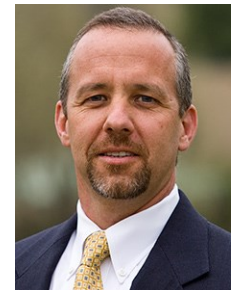
**Platform Session**  
*Stiteler Auditorium,  
Murphy Hall*



## Welcome!

Dear Students, Faculty, and Friends,

This day is truly a highlight of our program. Our curriculum centers around applying evidence to make clinical decisions in an effort to offer the most effective care possible. Each of these projects represents a collaborative effort between students and faculty, aimed at developing new knowledge to understand mechanisms that inform clinical practice. Case reports describe clinical practice decisions and the application of theory to practice. While many of these projects will be presented at professional conferences and some will go on to publication, the work is never finished. A key part of the research process, as well as clinical practice, is to reflect carefully about what the data suggest, ask questions, and consider what issues remain to be addressed. We hope that you will interact with student-researchers and use this opportunity to learn, question, and reflect on the knowledge guiding our clinical practice!



Phil McClure, PT, Ph.D, FAPTA  
Professor and Chair  
Department of Physical Therapy

## Table of Contents

<b>Agenda</b>	<b>4</b>
<b>Poster Presentations</b>	<b>7</b>
<b>Platform Presentations</b>	<b>30</b>
<b>List of Authors</b>	<b>39</b>
<b>Clinical Education Sites for the Class of 2017</b>	<b>40</b>

## Poster Session

9:30 am—12:30 pm

### Clinical Case Study Posters

- A. Effects of High Repetition, High Intensity Functional Balance and Gait Training Tasks to Improve Gait Performance and Reduce Risk of Falls in Community Dwelling Adult After Stroke
- B. SNF Level Functional Mobility Training of the Visually Impaired Patient Following Femoral Neck Fracture
- C. Efficacy of Combined Manual Therapy and an Individualized Exercise Program on Pain and Function in Adolescent Athletes
- D. The Importance of Considering the Proximal Tibiofibular Joint When Treating Lateral Knee Pain in a Long Distance Runner
- E. Improving Functional Mobility within the School Setting for a Child with Spina Bifida
- F. The Use of C1-C2 Rotation Manual Therapy (SNAGs) in a Patient with Cervicogenic Headaches
- G. Examining the Application of Strength Training as an Intervention for a Child with Duchenne Muscular Dystrophy
- H. Building Patient Rapport to Promote Recovery
- I. The Application of Custom Fit Orthotics to Supplement Therapeutic Exercise for Chronic Patellofemoral Pain Syndrome
- J. Rehabilitation and an Interval Hitting Program for an Adolescent with Scapular Pain During Baseball Hitting
- K. Use of Therapeutic Neuroscience Education in a Patient with Chronic Neck Pain
- L. The Role of Physical Therapy in a Multi-Disciplinary Approach to Treating Post-Concussion Syndrome in a Collegiate Athlete
- M. Use of Directional Preference to Alleviate Pain and Sensation Loss

## Poster Session

9:30 am—12:30 pm

### Clinical Case Study Posters, cont.

- N. Efficacy of Vestibular Rehabilitation in a Patient with Neurovascular Cross-Compression Syndrome of CN VII
- O. Successes and Struggles: The Role of Physical Therapy in Upper Extremity Burn Healing
- P. Treatment of a Peroneus Longus Tendon Repair: A Framework for Post-Operative Tendon Rehabilitation
- Q. Differential Diagnosis and Intervention of a Patient with Periscapular Pain and Radicular Symptoms
- R. The Efficacy of Low Load, Long Duration Stretching on Normalizing Gait and Increasing Functional Mobility for a Patient with Knee Flexion Contracture

### Faculty-Student Research Posters

- 1. Feasibility Study on Data Collection of Physical Therapy Interventions Following Total Knee Arthroplasty
- 2. Relationship of Muscle Power and Morphology to Function After Hip Fracture
- 3. Can Heart Rate Monitors be Used to Monitor Treatment Fidelity?
- 4. Effects of Manual, Instrument, and Electrical Stimulation Interventions on Myofascial Trigger Points in the Upper Quarter
- 5. International Interprofessional Education Experience: Ambergris Caye, Belize

## Platform Session

- 1:30** Introduction and Greeting from the Chair
- 1:45 — 2:00** 1. Best Practice Assessment and Interventions for Patients with Wounds in a Home Health Setting
- 2:00 — 2:15** 2. Perceptions of the Curriculum: The Arcadia Experience
- 2:15 — 2:30** 3. Physical Activity Participation and Enjoyment in Children with Down Syndrome
- 2:30 — 2:45** 4. The Effects of a Week-Long Intensive Stroke Camp on Outcomes in Patients with Chronic Stroke
- 2:45 — 3:00** 5. Reliability of Ultrasound Measurements of Rotator Cuff Muscle Cross-Sectional Area in Healthy Adults
- 3:00 — 3:15** Break
- 3:15 — 3:30** 6. The Effects of Eccentric, Concentric, and Isometric Contractions on Pain Sensitivity over the Achilles Tendon
- 3:30 — 3:45** 7. Differences Between Dynamic Functional Testing and Pressure Pain Threshold Values in Female Distance Runners With and Without a Prior Injury History Presentation
- 3:45 — 4:00** 8. Feasibility and Benefits of a Brief, Intense Exercise Program Targeting Balance, Gait, Endurance and Upper Extremity Function in Persons with Parkinson Disease: A Case Series
- 4:00 — 4:15** 9. Supraspinatus Structural Changes Observed with Ultrasound Imaging in Painful Adult Swimmers

## Effects of High Repetition, High Intensity Functional Balance and Gait Training Tasks to Improve Gait Performance and Reduce Risk of Falls in Community Dwelling Adult After Stroke

**Student:** Christina Yee

**Advisor:** Susan Tomlinson, PT, DPT

**Purpose:** Stroke rehabilitation studies cite benefits of high repetitions showing improved outcomes for patients in an acute rehabilitation setting but do not specify lower extremity tasks for potential dosing. This case report examines a treatment approach including dose-specific interventions that are high intensity, high repetition, and functionally task-oriented to target a patient post-stroke in an outpatient facility.

**Case Description:** An 82 year-old male 3 months post right medullary stroke presented to outpatient physical therapy with left sided weakness, gait and balance dysfunction. Exam revealed overall 4-/5 lower extremity (LE) strength, mild hypertonicity on left (L) LE, and right (R) lateral lean. Gait deviations included decreased L heel strike, R stride length and L stance time; decreased L knee flexion from initial swing into stance; and loss of balance with turning R. Interventions targeted 50-80 repetitions of segmental pre-gait activities, including stepping over a bolster to promote L stance and R stride length. Balance interventions included step-ups with arm swing, exaggerated step length with manual cuing on arm swing, cone targets with trunk rotation and overreaching to encourage step reaction, and ambulation with varying levels of cues, which decreased with increased repetition to enhance motor learning.

**Outcomes:** After a 14-week program, Timed Up and Go improved from 31.5 to 22.2 seconds (Minimal Detectable Change (MDC) = 2.9 seconds), 30-Second-Chair Rise test from 5 to 8 repetitions and now without upper extremity support (Minimal Clinically Important Difference (MCID) = 2 repetitions for hip osteoarthritis), 2 Minute Walk Test increased from 30 to 60 meters with rolling walker (RW) (MDC=13.4 meters) and preferred gait speed increased from 0.45 to 0.61 meters/second (MCID=0.16 m/s) with improved quality. Although cut-off scores were not met for significant reduction in falls risk, improved stability was noted. Ambulation improved from RW with moderate assistance to no RW with close supervision/contact guard for household distances, thus increasing independence.

**Discussion/Conclusion:** This case illustrates high repetition interventions that may be modeled for LE dosing in an outpatient setting. Although the patient's scores were still in the range of falls risk, functionally, the patient was safer with ambulation. Limitations included therapy time in outpatient care, age-influenced physical abilities with exercises, and adherence with a home exercise program.

## SNF Level Functional Mobility Training of the Visually Impaired Patient Following Femoral Neck Fracture

**Student:** Kathleen Resh

**Advisor:** Shailesh Kantak, PT, Ph.D

**Purpose:** Mobility outcomes are influenced by various non-motor comorbidities and therefore are important considerations for physical therapy (PT) prognosis, interventions, goals, and outcomes. Neuromyelitis Optica (NMO), also called Devic's disease, is a rare form of CNS disease. Previously thought to be a form of Multiple Sclerosis (MS), recent evidence indicates that NMO is distinct from MS, preferentially affecting the spinal cord and optic nerves. Here, we present a case of a patient with visual deficits secondary to NMO who was referred to PT after femoral neck fracture. The goal of this case is to highlight the role of skilled PT in restoring the patient to her prior level of functional mobility in presence of significant visual comorbidity.

**Case Description:** The patient for this case analysis is a 50 year old female, admitted to SNF rehabilitation after a fall causing a left femoral neck fracture, requiring surgical repair. Patient was weight bearing as tolerated on the left lower extremity immediately after surgery. Patient's past medical history is significant for NMO and Lupus, and is legally blind due to NMO. Initial evaluation showed limited active ROM in the left hip due to pain, impaired sensation in all limbs, impaired proprioception in right sided extremities, and increased tone in lower extremities with sustained clonus of heel cords. Prior to admission, patient required supervision level care in the home and supervision-minimal assistance in the community.

**Interventions:** PT interventions included a combination of compensatory bed mobility training, transfer training, wheelchair management, proprioceptive training, strength training, neuromuscular re-education/balance training, gait training with use of assistive devices and home health aide, and caregiver training.

**Outcomes:** Outcome measures included AMPAC, KUBS, and gait speed. At discharge, the patient made statistically significant improvements in AMPAC and KUBS scores, and had a gait speed of 0.26m/s demonstrating dependence in community ambulation and high risk of falls, however must take into consideration patient's comorbidity of visual impairment. Patient returned home with continued home health aide assistance and outpatient PT.

**Discussion:** In this case analysis, we see that the patient returned to prior level of function, however had the potential to make further functional gains in outpatient PT. Hand over hand tactile cues, guided practice, repetition, and interventions targeting multiple impairments, proved to be advantageous towards improving this patient's independence in functional mobility. In this case, the varying types of teaching methods became a critical part in our PT intervention. More research needs to be conducted on the most beneficial PT interventions for visually impaired patients due to NMO.

## Efficacy of Combined Manual Therapy and an Individualized Exercise Program on Pain and Function in Adolescent Athletes

**Student:** Seth Pogasic  
**Advisor:** Scott Stackhouse, PT, Ph.D

**Purpose:** Low back pain is the most common issue seen in physical therapy. This case study aims to investigate the effectiveness of manual therapy and exercise at different stages of rehabilitation, and emphasizes the need for thorough biomechanical analysis to address the movement system. This case study seeks to examine the hypothesis that strengthening core and proximal hip musculature will increase function and decrease pain throughout the lower extremity kinetic chain.

**Case Description:** A 16 year-old female, about 4 years ago, stepped on glass and required surgery to close the wound. In the Spring of 2016, a 2<sup>nd</sup> surgery was performed to remove remaining glass and she was NWB for 4 weeks and transitioned to a walking boot for 6 weeks. During this time she grew ~ 15 cm (6 inches). She had progressively worsening pain in foot/hip/back since that time. She was a high level athlete, playing lacrosse for both school team and travel team on weekends, and her goal was to return to lacrosse with minimal symptoms. Early intervention included manual therapy focused on low-grade mobilizations to reduce irritability of painful lumbar joint segments and irritable musculature. As irritability decreased, sessions focused on closed chain, functional strengthening including double/single leg balance, squats, lunges, and core strengthening.

**Outcomes:** Outcome measures used included (Pain Intensity-Numeric Rating Scale) PI-NRS (patient chief complaint), proximal hip Manual Muscle Testing (MMT), Focus on Therapeutic Outcomes (FOTO), and single leg squat test. Patient showed improvements in all measures at the conclusion of the case. Pain rating decreased from 5-9/10 to 0-2/10, surpassing the value needed to be deemed clinically important of 2 points. Hip MMT scores increased from 3+ globally to 5, with the exception of abduction on the right, which increased to 4+. FOTO scores increased from 47 to 61. Single leg squat test on initial evaluation showed, decreased posterior translation of center of gravity (COG), and increased knee valgus, with patient unable to fix this with cueing. Single leg squat improved with increased posterior translation of COG and no knee valgus noted on any repetitions. It is important to note that while pain was initially decreased with manual therapy, pain was eliminated only after a more intense exercise program focusing on both strength and control of core and proximal hip musculature.

**Discussion:** Low back pain is the most common condition seen across outpatient orthopedic physical therapy. This case report examines the efficacy of manual therapy and exercise as part of a comprehensive physical therapy program that addressed the movement system of the trunk and lower extremities.

## The Importance of Considering the Proximal Tibiofibular Joint When Treating Lateral Knee Pain in a Long Distance Runner

**Student:** Anika Perkins  
**Advisor:** Karen Sawyer, PT, DPT, MA

**Purpose:** Dysfunction at the proximal tibiofibular joint may be an important contributor to lateral knee pain, though often overlooked. Beazell et al (2009) found that addressing hypomobility at this joint can improve function and decrease pain<sup>1</sup>. The purpose of this case study is to examine the effects of combining manual therapy of the proximal tibiofibular joint with strengthening and stretching exercises when addressing knee pain in a recreational runner.

**Case Description:** The patient is a 27 year-old male with lateral knee pain which began while running after reaching a 3 mile distance. Knee special tests were negative and lumbar spine pathology was ruled out. Tinel's test over the common fibular nerve reproduced symptoms locally but did not cause any paresthesia down the leg. Thomas test was positive on the left, Noble's compression test was negative, and slight hypomobility was noted at the left proximal tibiofibular joint. Hip abduction endurance was tested using sidelying hip abduction holds to fatigue while maintaining correct form, and this demonstrated that hip abduction endurance on the left side was decreased to only 62% of that on the right side. All lower extremity muscle groups tested at 5/5 for strength, with the exception of bilateral gluteus maximus muscles, which tested at 4/5. Based on these findings, stretching and strengthening exercises were implemented to address the muscle imbalance. After several sessions, grade IV mobilizations to the left proximal tibiofibular joint were also implemented in order to improve mobility and assess if it had any carry over with running, and these were eventually progressed to mobilizations with movement to the proximal fibula. After 4 weeks, McConnell taping was added to pull the fibular head anteriorly following mobilizations in an attempt to maintain alignment during running and further reduce his pain.

**Outcomes:** After 6 weeks, improvements were seen in hip abduction endurance, gluteus maximus strength, flexibility of the hip flexors, Lower Extremity Functional Scale (LEFS), and Patient Specific Functional Scale (PSFS). The LEFS and PSFS were used to assess self-perceived function of the affected lower extremity, enabling us to see a positive change in his ability to participate in functional activities such as running. The patient also reported decreased frequency and severity of his pain using the Numeric Pain Rating Scale, as well as an increase in pain-free running distance.

**Discussion:** Future research should be conducted targeting the proximal tibiofibular joint as it is largely overlooked when assessing a patient with knee pain. Specific emphasis should be placed on manual therapy for the proximal tibiofibular joint as well as taping to maintain alignment.



## Improving Functional Mobility within the School Setting for a Child with Spina Bifida

**Student:** Hilary Park

**Advisor:** Karen Sawyer, PT, DPT, MA

**Purpose:** For many children born with congenital disabilities, levels of independence during ambulation and functional mobility vary, and are often times reduced, as compared with their typically- developing age-matched peers. As the school setting provides important psychosocial, cognitive and physical benefits for students with disabilities, it is necessary for them to be able to negotiate their school environment safely and efficiently, in order that they might optimize their learning environment. This case report looks at the effects of a lower extremity strengthening and walking endurance program for a pediatric patient with spina bifida occulta within the school setting over the course of 10 weeks.

**Case description:** The patient is 14-year-old male with spina bifida occulta and hydrocephalus, receiving school-based physical therapy services to address current limitations in range of motion, strength and mobility. Family stated goals include increasing walking endurance, and decreasing the time required to ascend and descend one flight stairs safely, with use of bilateral AFOs, so that he can successfully participate in the school environment.

**Methods:** The patient underwent therapy for 30 minutes a week, consisting of stretching, core and lower extremity strengthening, and walking circuit with stair negotiation, for a total of 10 weeks. An initial gross motor assessment was performed using the 6 Minute Walk Test (6MWT), gait speed and Timed Up and Down Stairs (TUDS) to assess patient's baseline balance, coordination and mobility. Patient received therapy services in the classroom, and walking endurance was performed in the school hallways and staircases.

**Outcome Measures:** Outcome measures of 6MWT, gait speed and TUDS were utilized to document the patient's progress over the course of 10 weeks. Tests were performed at four intervals: initial session, two intermediate sessions and the final session.

**Results:** The patient exceeded the MCID for 6MWT (34.4 meters, Tang et al, 2012) and MDC for gait speed (0.1m/s, Ries et al, 2009), and demonstrated overall improvement in functional mobility following this 10-week school-based physical therapy program. As compared with initial scores, the patient showed improvement in the 6MWT and gait speed by 48.9% and 47.3%, respectively, and TUDS decreased by 67 seconds.

**Discussion:** This case study reveals the efficacy of school-based physical therapy in addressing deficits in functional mobility in the case of one pediatric patient with spina bifida. Further research may be warranted to determine the long term effects of a strengthening and endurance program on the functional mobility of individuals with spina bifida, by way of a randomized control trial or other higher level evidence.

## The Use of C1-C2 Rotation Manual Therapy (SNAGs) in a Patient with Cervicogenic Headaches

**Student:** Joshua Meunier

**Advisor:** Philip McClure, PT, Ph.D, FAPTA

**Purpose:** The prevalence of cervicogenic headaches in the general population has been estimated at 15-20%<sup>1</sup>. Manual therapy, postural correction exercises, and upper extremity strengthening have been shown to be effective conservative treatment in the management of cervicogenic headaches<sup>1,2,3,4,5,6</sup>. In particular, Mulligan rotation sustained natural apophyseal glides (SNAGs) to C1 and C2 have shown great results<sup>6</sup>. One study found that rotation SNAGs performed to the side with restricted cervical active range of motion decreased headache severity<sup>6</sup>. The goal of this case report is to describe the use of manual therapy and exercise in a patient with cervicogenic headaches.

**Case Description:** A 54 year-old female patient had been suffering from several headaches a week for the past two years. She had sought several other treatment options over that time, including visits to an ear nose and throat doctor, chiropractor, and her family doctor. She had not found any relief for her headaches before coming to Physical Therapy. An examination and evaluation found limited mobility of cervical and thoracic spine, tight upper trapezius muscles, and forward head posture. She was treated with a combination of postural exercises, upper extremity strengthening, manual therapy, and C1-C2 rotation SNAGs over the course of one month.

**Outcomes:** Cervical flexion ROM improved from 30 degrees to 50 degrees. Cervical extension ROM improved from 20 degrees to 60 degrees. Right/left cervical sidebending improved from 30 degrees bilaterally to 45 degrees bilaterally. Right/left cervical rotation improved from 45 degrees/30 degrees to 80 degrees bilaterally. Initial pain level was 8/10 when headaches were present. The patient now rates her pain as a 5/10 when headaches are present. The patient used to experience headaches 4-5 days out of the week and now experiences headaches 0-1 times per week. Neck Disability Index score improved from 20% to 8%.

**Discussion:** This case suggests chronic cervicogenic headaches can be improved with a combination of postural exercises, UE strengthening, manual therapy, and C1-C2 SNAGs. The results of this case agree with with prior studies, which found a decrease in cervicogenic headaches after using C1-C2 SNAGs<sup>6</sup>. Further studies are necessary to figure out which interventions were of greatest benefit to the patient.

## Examining the Application of Strength Training as an Intervention for a Child with Duchenne Muscular Dystrophy

**Student:** Shannon Massott

**Advisor:** Ann Tokay Harrington, PT, DPT, Ph.D, PCS

**Purpose:** Duchenne Muscular Dystrophy (DMD) is a genetic disorder characterized by muscle fibers that are abnormally vulnerable to contraction-induced injury due to lack of dystrophin. There is mixed evidence on the effect of exercise on muscle in children with DMD. This case report describes a therapy bout including strength training, in a child with DMD.

**Case Description:** The subject of this case is a 5 year-old with DMD. He presented with low endurance, proximal muscle weakness, and decreased range of motion, but ambulated community distances independently. He walked on his toes with a lordotic posture, wide base of support and lateral trunk lean. He had difficulty climbing stairs (requiring a railing), running, jumping, and rising from the floor (full positive Gowers' sign). The Batelle Developmental Inventory (BDI) was administered at the start of therapy, and he received a raw score of 65 (age equivalence of 2 years, 9 months).

**Intervention:** School-based physical therapy was provided twice a week for 30 minutes, for 12 weeks. Treatment sessions involved 10 minutes of core strengthening activities (e.g. sit-ups, scooter board activities, leg lifts, reaching in half kneel, and therapy ball exercises), 10 minutes of lower extremity strengthening (squats, climbing a rock wall, jumping), and 10 minutes of functional exercises for core and lower extremity strengthening (stair mobility, playground equipment, transfers and sitting posture training). All exercises were performed to fatigue.

**Outcomes:** The BDI was administered at the end of 12 weeks of strength and functional training. The subject achieved a raw score of 68 (age equivalence of 3 years).

**Discussion:** DMD causes muscle degeneration and weakness secondary to lack of dystrophin and decreased ability to remodel after damage. While there is evidence of risk from eccentric and high intensity exercise, it is not known whether moderate exercise is beneficial in this population. There is a fine line between inappropriate or excess strength training causing muscle breakdown and avoiding exercise, causing disuse atrophy. The subject of this case report had a higher BDI score after 12 weeks of therapy, which shows no regression in functional mobility or gross motor skills. Limitations to this report include single case design and training dosage not being specifically measured. Further research is needed to establish evidence-based recommendations regarding optimal training modes for patients with DMD.

## Building Patient Rapport To Promote Recovery

**Student:** Emanuela Mannino

**Advisor:** Amy Miller, PT, DPT, Ed.D

**Purpose:** Cancer incidence and survival rates increase each year leaving survivors with residual physical limitations that physical therapy can address. For optimal outcomes, patient participation is key and depends on the patient's view of therapy that is shaped by prior experiences and psychological perspectives. There is minimal literature addressing specific strategies for the behavioral management. The transtheoretical model has been used previously for behavioral management. This model provides a framework to stage and guide the patient's behavioral status when participating in a program. This case report documents strategies used to help change a patient's attitude for optimal outcome.

**Description:** A 73 year-old male presented with a chief complaint of progressive right shoulder weakness and functional decline four months following radical neck dissection. The patient's limitations at the start of care are as follows: active shoulder motion was 80 degrees of abduction and 111 of flexion, and FOTO and PSFS were 50% and 60% respectively. The patient was unable to reach overhead or participate in recreational activities.

Perceptions of his disability, negative past experiences with physical therapy and mismatched teaching strategies initially limited adherence to interventions. The therapist determined the patient to be at the pre-contemplative stage of the transtheoretical model. He was not receptive to pure strengthening nor working with a student. Development of a positive therapeutic relationship was a central part of his plan of care (POC). Teaching strategies and approaches matching the patient's readiness for change were applied based on the patient's perceived and objective limitations to improve shoulder function.

**Outcomes:** The patient was seen for 21 visits over 15 weeks. After 2 weeks of minimal progress, the approach was changed to focus on guiding the patient through the stages of behavioral change. Intensity and mode of exercise were modified to ensure success and comfort. Reassurance and repeated education of injury, pain and aim of exercises led the patient to be more willing to participate by week 6. Once at the action stage, he was able to open discussions about functional limitations and problem solve. At discharge, he was able to lift 10 pounds overhead and returned to golf. He was confident to continue his program independently and had progressed to the maintenance stage.

**Discussion:** Functional limitations can have both physical and behavioral components. An adequate exercise program and patient adherence are crucial elements for an effective POC. Establishing a positive rapport and recognition of patient readiness for therapy early on can promote faster recovery. This case demonstrates using best clinical judgment of objective measures and patient's behavioral status to treat the patient throughout POC.



## The Application of Custom Fit Orthotics to Supplement Therapeutic Exercise for Chronic Patellofemoral Pain Syndrome

**Student:** David Lorenzo

**Advisor:** Michael Tevald, PT, Ph.D

**Purpose:** Patellofemoral Pain Syndrome (PFPS) is a common disorder that affects up to 40% of active individuals. Several factors can contribute to the development of PFPS including weakness of the hip abductors, external rotators and quadriceps, along with tightness of the IT band and hamstrings. Additionally, excessive pronation can increase aggravating forces at the knee. Custom orthotics have been shown to mitigate these issues, but can cost upwards of \$400. The purpose of this case report is to highlight the potential benefits custom fit orthotics can have in certain patients with PFPS while illustrating the decision making process to recommend them.

**Case Description:** The patient is an active 28 year old male with chronic bilateral knee pain for the last 5 years. He exhibited several positive tests indicating PFPS including eccentric step test (+2.34 LR), Clarke's test (+1.94 LR), and patellar apprehension test (2.26+). He also reported a maximum of 7/10 pain during ambulation. According to MMT, he exhibited weak hip abductors, hip extensors, and quadriceps. Also, the patient displayed significant pes planus with a navicular drop test of 16mm, indicating excessive pronation during stance. A strengthening program was initiated as consistent evidence indicates hip and knee strengthening is effective for decreasing pain and improving function. The hip strengthening program consisted of clamshells, hip abduction with cuff weights, single leg squat, lateral walks with resistance, and unilateral glute bridges. The quadriceps strengthening program included quad sets, TKE, short/long arc quads, and leg press. Stretching of the hamstrings and IT band were added to improve tissue length and decrease joint reaction force. After 6 weeks of therapy paired with an HEP, the patient was unable to make significant progress toward goals despite increases in strength. PT recommended orthotics after lack of progress and evaluation that excessive pronation was causing poor ambulation and running mechanics. He was fit for medial post carbon fiber orthotics via podiatrist and progressed to full time use in 3 weeks.

**Outcomes:** All goals were achieved in 4 sessions after progressing to full time orthotic use, including pain free ambulation, pain free return to manual labor work, and ability to tolerate a return to his exercise program with only mild increases in pain. He exhibited significant increase in LEFS from a 70 to a 79/80 indicating perceived functioning at 98.75%, as well as an increase in FOTO score from a 62 to an 89/100.

**Discussion:** This case highlights the notion that not all individuals with PFPS respond to standard therapeutic exercise alone, and addressing excessive motion in the foot is imperative in order to return to maximal functioning.

## Rehabilitation and an Interval Hitting Program for an Adolescent with Scapular Pain During Baseball Hitting

**Student:** Sean King

**Advisor:** Michael Tevald, PT, Ph.D

**Purpose:** Approximately 13 million youths in the United States participate in league play baseball. The incidence of shoulder pain in this population is estimated to be 15.9% . While many of these injuries may be attributable to overhead throwing, hitting during baseball is also a high velocity activity that puts an athlete at risk of injury too. The purpose of this patient case report is to outline a rehabilitation return to sport program for an adolescent male patient suffering from shoulder pain during hitting.

**Description:** A 13-year-old male with R scapular pain and stiffness that began during a baseball swing follow-through 6 weeks prior. The patient received a medical diagnosis of scapular dyskinesis/snapping scapular syndrome, instructed to avoid hitting, and to report to physical therapy. Patients goal is to return to hitting during competitive baseball. With focus being on the key physical requirements of baseball hitting especially during the follow through phase, the targeted initial examination revealed relevant impairments in AROM (> 20 degree total arc difference RUE to LUE, 45 degrees of HORZ. ADD and 45 degrees of axial trunk rotation bilaterally), muscular strength/stabilization/ endurance (side plank 30 sec. bilaterally, prone plank 45 sec., MMT bilaterally: quadriceps 4/5, scaption 3/5, serratus anterior 3/5, posterior deltoid 3/5), and neuromuscular control (FSD 3/6, SEBT: Ant. L 50 cm. /R 50 cm.).

The patient completed 12 weeks of twice-weekly rehabilitation consisting of four sequential phases with the following objectives: 1) normalize motion for hitting with sleeper, cross body, and thoracic stretches. 2) isolated strengthening for active muscles in kinetic chain of the follow-through phase being: quadriceps, supraspinatus, post. deltoid, obliques, erector spinae, and serratus anterior. 3) neuromuscular control and dynamic stability with these muscle groups in hitting context. 4) Interval return to hitting program and HEP.

**Outcomes:** At week 12 the patient reported meaningful change in total Shoulder Pain and Disability Index (week 1 - 19.27%, week 12 - 0.00%) and was cleared by physician for return to sport.

**Discussion:** Despite the popularity of youth baseball and high incidence of shoulder injury amongst its players, rehabilitation research surrounding hitting is limited, leaving little in the literature to compare the treatment and outcomes of this case to. This case may be helpful to aide therapists, trainers, coaches, and parents in guiding a treatment approach for youth baseball players with shoulder pain during hitting so they can work towards a safe return to the high physical demands of swinging a bat. However, all could further benefit from extended biomechanical, EMG, and rehabilitation clinical studies to drive a more evidence based approach in this area.

## Use of Therapeutic Neuroscience Education in a Patient with Chronic Neck Pain

**Student:** Devon King  
**Advisor:** Michael Tevald, PT, Ph.D

**Purpose:** Chronic pain is widespread, non-specific pain that persists beyond the expected healing time. Traditional approaches have little to no effect in pain reduction and return to function, possibly because of pain-related fear. Therapeutic Neuroscience Education (TNE) is a form of Cognitive Behavioral Therapy that teaches patients about their pain, while deemphasizing anatomy. This case study will illustrate the use of TNE along with traditional interventions for a patient with neck pain.

**Case Description:** A 58-year-old woman reported 3 month history of neck pain. She was injured while restraining a student working as a special education assistant. On initial examination, range of motion was moderately limited in left cervical side bending and minimally limited in cervical rotation bilaterally. Pain at rest was 7/10 and 9/10 with movement. Patient was fearful of moving and causing re-injury. Functional limitations were cleaning and driving, and she was on light duty at work. NDI score was 34%. She attended physical therapy for 11 sessions in 5 weeks. Treatment involved exercises (cardiovascular, stretches, strengthening, neurodynamics) and manual therapy, as a combination of these interventions is most effective in reducing neck pain. TNE was also included because of the chronicity and patient's fear of movement, and recent evidence demonstrating its effectiveness in reducing pain and disability, and improving physical performance in chronic musculoskeletal conditions. The goal of TNE is to increase the patient's knowledge of pain to reduce fear associated with injury. This is done by explaining the neurobiology of pain and the physiology of the nervous system using pictures and metaphors that are easy to understand. For this patient, an abbreviated TNE was used over the first few sessions.

**Outcomes:** At discharge, patient had no limitations in ROM, 0/10 pain at rest and 5/10 pain only with lifting her neck while sleeping. NDI was 26%, which reflects clinically significant change (MCID = 7%). She had no functional limitations, and was cleared to work with no restrictions. Most importantly, patient was no longer fearful of movement.

**Discussion:** TNE may be an important addition to traditional therapy in patients with chronic pain. It has been shown to be effective in reducing fear associated with musculoskeletal injury, which results in decreased pain and return to function.

## The Role of Physical Therapy in a Multi-Disciplinary Approach to Treating Post-Concussion Syndrome in a Collegiate Athlete

**Student:** Lindsey Fisher  
**Advisor:** Susan Tomlinson, PT, DPT

**Purpose:** Athletes in the U.S. sustain 300,000 sport-related concussions each year. Despite emerging evidence, questions remain concerning the most appropriate and effective treatment strategies for patients who have sustained sport-related concussions. The current shift in literature recommends an active recovery process which promotes a controlled return to premorbid function to achieve full recovery and decrease risk of future injury. The purpose of this case study is to illustrate the role of physical therapy among a team comprised of physical, occupational and speech therapists to achieve an active recovery targeting the multi-faceted symptoms of post-concussion syndrome (PCS).

**Case Description:** This case study presents a 20 year-old male college football player who sustained a non-traumatic concussion during a preseason scrimmage. This patient reported a history of 2 prior concussions in the previous year for which he received minimal treatment beyond cognitive and physical rest. The patient presented to outpatient therapy 1-month status-post concussion with symptoms of headaches, nausea, blurred vision, difficulty concentrating and mood swings. Evaluation revealed deficits in exercise tolerance, balance, ocular-motor coordination and hand-eye reaction time. Interventions chosen to target these deficits included a sub-threshold aerobic exercise program, balance training and ocular-motor training. Treatment progressed to agility activities with the addition of Nike Strobe glasses to improve reaction time and yoked prism glasses to improve ocular-motor coordination. The patient simultaneously received vision therapy provided by an OT and cognitive therapy provided by a ST.

**Outcomes:** Outcome measures included Sensory Organization Test (SOT), Balke protocol for submaximal treadmill testing, Post-Concussion Symptom Scale (PCSS) and hand eye reaction time tested with Sanet Vision Integrator (SVI) software. After 8 weeks, exercise tolerance increased as evidenced by an increase in treadmill test maximum heart rate from 138 to 173 bpm, and balance improved as evidenced by an increase from 64.2/70 to 81.7/70 on the SOT. Subjective symptom report decreased from 50 to 3 points on the PCSS, and reaction time decreased from 1.13 to 0.73 seconds.

**Discussion:** This case suggests that a multi-disciplinary, active recovery is effective for treating PCS. The PT, OT and ST communicated regularly to monitor patient progress and to integrate tasks of balance, vision and cognition into each therapy. For example, yoked prism glasses were worn during all therapies to correct a visual midline shift, and cognitive challenges were included in all therapies to improve dual tasking. After 8 weeks, the patient was able to perform sport-specific activities safely and symptom free with appropriate speed, balance and reaction time.

## Use of Directional Preference to Alleviate Pain and Sensation Loss

**Student:** Charles Erney

**Advisor:** Kristin von Nieda, PT, DPT, M.Ed

**Purpose:** The following case study focuses on the management of an acute cervical radiculopathy in a young, athletic male. Cervical radiculopathy, with an annual incidence of 107.3 per 100,000 males and 63.5 per 100,000 females, can inflict pain and sensation loss in patients. Due to a widespread of symptoms that can occur with cervical pathologies, including pain referral patterns to the shoulder, upper arm, and scapulae, it is crucial for the clinician to recognize and effectively intervene upon patients who exhibit these symptoms to avoid further nerve root irritation and loss of ability to work or participate in recreational activities.

**Case Description:** The patient chosen for this case study is a 25 year-old male who sustained an acute exacerbation of left-sided cervical and shoulder pain and sensory loss resulting from a non-contact injury while playing pool volleyball. Five days after injury he was seen by his physician, who prescribed muscle relaxant and referred him for physical therapy. The patient works full-time as a machine operator and is required to lift objects weighing up to 50 pounds and push objects weighing up to 160 pounds. He has been out of work since the injury occurred.

Upon examination patient displayed significant limitations in active glenohumeral external rotation, internal rotation, and signs of instability. Active cervical extension and left lateral flexion reproduced pain and sensory symptoms. Due to the acuity of the injury and presence of diminished sensation, centralization of pain and sensory symptoms was the initial goal for the patient. Interventions included two sets of ten repetitions of pain-free cervical flexion and left rotation, five repetitions of median nerve glides, and two sets of ten repetitions of pain-free scapular adduction per day. During the following visits the patient demonstrated centralization of pain and paresthesia. After the fifth visit, he was able to return to work without symptoms and discontinued physical therapy.

**Outcomes:** Focus on Therapeutic Outcomes FOTO (FOTO), Disabilities of Arm, Shoulder, and Hand (DASH), Numeric Pain Rating Scale (NPRS), and patient's subjective report on centralization of symptoms were used as outcome measures. Patient initially presented with a FOTO score of 41, DASH of 62.5%, and NPRS of 7/10. At the fourth visit patient achieved significant changes in all three outcomes, scoring 67 on FOTO (MDC = 4), 14.2% on DASH (MDC = 12.75%), and 3/10 on NPRS (MDC = 2).

**Discussion:** The interventions in this case study included multiple repetitions per day of pain-free cervical active range of motion during the acute phase of treatment to centralize symptoms. This combination of pain-free cervical motions within the two-week treatment period may have contributed to the centralization of symptoms.

## Efficacy of Vestibular Rehabilitation in a Patient with Neurovascular Cross-Compression Syndrome of CN VIII

**Student:** Shiloh Eilert

**Advisor:** Janet Readinger, PT, DPT

**Purpose:** Vestibular paroxysmia is a condition in which direct, pulsatile pressure on the vestibulocochlear nerve (CN VIII) causes vertiginous symptoms lasting seconds to minutes. The cause is often linked to neurovascular cross-compression syndrome due to a lesion in close proximity to CN VIII. A lesion in this region may elicit multiple neurologic paroxysmias, including trigeminal neuralgia. About 20-45% of those with neurovascular compression often show signs and symptoms of a unilateral vestibular hypofunction (UVH). MRI is the gold standard to diagnose the condition, however a positive response following use of anticonvulsants is an indicator of the disorder. The purpose of this case study is to describe the outcomes following vestibular rehabilitation in a patient with vestibular paroxysmia caused by an arachnoid cyst that presents with an acute onset of vertiginous symptoms.

**Description:** Patient is a 79 year-old female with an acute onset of short bouts of vertigo. She has a history of trigeminal neuralgia caused by an arachnoid cyst in her left temporal region that has been treated with gamma knife radiation. Use of anti-convulsant medication was initiated one week prior to the initial evaluation. A vestibular-ocular examination revealed a positive left head thrust (+LR 4.16) and a three-line difference with dynamic visual acuity testing (DVA), indicative of a left UVH. Functional Gait Assessment (FGA) was administered and indicated impaired dynamic balance and static balance assessment revealed balance below age-matched norms. Motion Sensitivity Quotient (MSQ) testing was positive with multiple positional changes. Testing for benign paroxysmal positional vertigo (BPPV) was negative. She was treated with a variety of therapeutic exercises per current clinical practice guidelines for a UVH, including gaze stabilization, static and dynamic balance and habituation training.

**Outcomes:** Following treatment, 2 times a week for 8 weeks, patient demonstrated improved DVA (0 line difference), static and dynamic balance equal to age-matched norms, gait speed adequate to cross the street and reduced motion sensitivity. Additionally, patient reported no recent episodes of vertigo and was discharged at a low risk for falls.

**Discussion:** Balance and vestibular deficits were improved following vestibular rehabilitation in conjunction with medical management. While anticonvulsants have been shown to be effective in abolishing vertiginous symptoms in subjects with neurovascular cross-compression syndrome, it is uncertain if medical treatment alone is sufficient to restore balance impairments. Future studies may investigate the efficacy of vestibular rehabilitation with, and without medical management for those affected by neurovascular cross-compression syndrome.

## Successes and Struggles: The Role of Physical Therapy in Upper Extremity Burn Healing

**Student:** Erika Clark

**Advisor:** Susan Tomlinson, PT, DPT

**Purpose:** This case was selected to describe the healing progression of the hand/forearm after severe burns and to explore the role of Physical Therapy in burn care. The patient's progress demonstrates the importance of patient adherence to the care plan in addition to management of necrotic tissue and decreasing risk of infection.

**Case Description:** A 58-year-old man sustained 2nd and 3rd degree burns over right hand/forearm after a mechanical fall involving hot tar at work as a roofer. He received a split-thickness skin graft (STSG) over the anterior forearm and dorsum of the hand, and arrived to outpatient physical therapy wound care on post-op day 7 with 75% yellow slough in the wound bed outside of the STSG. Hospital guidelines for STSG were used. Twice weekly, wounds were cleansed with saline and chlorhexidine, necrotic tissue was debrided, bacitracin applied to STSG, and Santyl applied to necrotic tissue for enzymatic debridement. Primary dressings included Mepilex Ag to decrease risk of infection and manage drainage, and Conformant on STSG to minimize adherence to wound bed. Secondary dressings included Burn Pac gauze, Kling, and elastic netting. Each session preceded a session with Occupational Therapy, and included ranging of wrist/digits, review of printed of exercises, visualization of contractures, review of goals, and plan of care. Music was played throughout each session to decrease anxiety and pain with dressing changes. Complications throughout the healing process included green drainage, indicating pseudomonas infection, maceration in peri-wound, and noted non-adherence to home exercises. Vashe was applied to manage green drainage, and Iodosorb on Adaptic replaced Mepilex Ag and Santyl to manage the amount of drainage. Coban was used to provide temporary compression, and was later replaced with various gloves and sleeves to provide more even compression.

**Outcomes:** The patient had continued poor adherence to exercises and compression therapy throughout the episode of care due to discomfort, despite continuous re-education, resulting in wrist/digit contractures, hypertrophic scarring, and persistent edema. Although all but 1.3x1.5cm was fully healed after 21 treatment sessions, and goals for serosanguinous drainage and 0% necrotic tissue were met, non-adherent behaviors increased healing time by poorly managing edema and preventing timely wound closure.

**Discussion:** This case emphasizes the importance of exercise adherence outside of therapy to manage edema for wound healing and to regain functional motion. It also shows the importance of infection management, compression, and necrotic tissue debridement for healing after severe burns. While current literature confirms that 2nd and 3rd degree burns have lengthy healing processes, more focus is needed on the specific effects of compression and exercise adherence for healing prognoses.

## Treatment of a Peroneus Longus Tendon Repair; A Framework for Post-Operative Tendon Rehabilitation

**Student:** Michael Cioffi

**Advisor:** Marty Eastlack, PT, Ph.D

**Purpose:** There is currently no medical consensus on the rehabilitation (rehab) of peroneus tendon repairs, with no standardized length of immobilization or widely accepted treatment protocol available. Without clinical practice guidelines, it is crucial to approach rehab in phases which correspond to physiologic stages of healing. The proposed methodology suggests three distinct phases of treatment; an initial phase focusing on regaining range of motion (ROM), a second phase focusing on regaining strength, and a third phase initiating plyometric activity to allow for return to sport. The purpose of this case study is to outline the use of this framework for treatment of a patient post peroneus longus tendon repair.

**Case Description:** The patient is a 40 year-old male who presented to therapy 8 weeks post-surgery. Prior to surgery, he was a recreational marathon runner and triathlete, who developed peroneal tendon dysfunction (chronic subluxation) of his left (L) ankle while training for a marathon. His main goal for therapy was to return to competitive running. He presented with no red-flags.

**Evaluation:** Initial evaluation followed 2 weeks in soft cast, 5 weeks in a walking boot, and 1 week in an ankle brace. The primary examination findings were global ROM limitation, global weakness of the L ankle musculature and reported limitations in function.

**Intervention:** The patient was treated a total of 30 times following his initial evaluation (generally 2x/week) with four formal re-evaluations prior to discharge. Treatment strategies varied by phase: Phase 1 focused on passive ROM stretching and active ROM exercise; Phase 2 focused on progressing strength and stability demands; Phase 3 initiated pre-plyometric activity, plyometric activity, and a return to run program. Phases were progressed once the primary goal of each phase was reached.

**Outcomes:** Primary outcome measures were AROM, MMT scores, a modified stair climb test, and the LEFS score. Over the course of his 5 month treatment program, the patient met all of his long-term impairment goals. The Phase 1 goal exceeded the MDC for dorsiflexion (DF) and plantarflexion (PF) AROM. The Phase 2 goal exceeded the MDC of 1 grade for DF, PF and eversion strength. The Phase 3 and personal rehab goal of returning to running was met at his final evaluation with associated improvements in his stair climb test performance. His improvement in the LEFS greatly exceeded the MDC/MCID.

**Discussion:** The proposed method of rehabilitation utilizing a three stage framework applies the principles of tendon healing and allows for a safe, effective, and personalized treatment protocol and seemed to allow for return to sport and function in this patient post tendon repair. This method aligns well with existing literature pertaining to the rehabilitation of tendinopathy, as well as protocols for other tendon repairs.



## Differential Diagnosis and Intervention of a Patient with Periscapular Pain and Radicular Symptoms

**Student:** Eric Ciabattoni  
**Advisor:** Carol Oatis, PT, Ph.D

**Purpose:** It is important that clinicians perform accurate evaluations to confirm or deny a given diagnosis if the patient's presentation suggests an additional, or alternate diagnosis. In this case, in addition to the musculoskeletal examination of the upper extremity, it was important to consider cervical, thoracic, and scapular osteokinematics, as well as neural involvement. Thorough examination of the clinical presentation facilitated an accurate evaluation and guided treatment. The objective of this case report is to present the clinical findings that were useful in the differential diagnosis of a patient with cervical radiculopathy, followed by a presentation of the interventions used throughout the patient's plan of care.

**Description:** The patient under review was a 59-year-old female who presented for initial evaluation following injury sustained during right horizontal adduction. The patient was given an original diagnosis of right lateral epicondylitis. The patient's symptoms included cervical and mid-thoracic pain, loss of cervical range of motion in all planes, and right-sided radicular symptoms along median nerve bias. All clinical prediction rule criteria for cervical radiculopathy were satisfied and focus shifted towards radicular symptoms and limitations in cervical motion. Cervical traction and strengthening of scapular stabilizers were utilized as primary interventions, and were accompanied by soft tissue deformation, neural tissue mobilization, and modalities until irritability decreased and cervical involvement could be assessed further. Consistent moderate-high irritability limited the assessment of deep cervical neck flexor strength.

**Outcomes:** The Numeric Pain Rating Scale (NPRS) was administered at the beginning and end of each session. All other outcomes measures were administered at initial evaluation, every 4-5 visits, and at discharge. Focus on Therapeutic Outcomes (FOTO) and Patient Specific Functional Scale (PSFS) were used to measure progression of functional status and participation. Specific body parts in question were monitored using the Neck Disability Index (NDI) and the Disability of the Arm, Shoulder, and Hand (DASH) outcome measures. In addition to an increase in function per patient report, the minimal clinically important difference (MCID) was met in all values at time of discharge.

**Discussion:** Keeping an open mind is important throughout initial evaluations to develop an effective, patient-specific plan of care. Following accurate diagnosis, a review of current literature aided in selecting appropriate interventions. The patient in review responded predominantly to cervical traction and scapular stabilization exercises, which resolved the two main chief complaints of pain and decreased function.

## The Efficacy of Low Load, Long Duration Stretching on Normalizing Gait and Increasing Functional Mobility for a Patient with Knee Flexion Contracture

**Student:** Joseph Bertucci  
**Advisor:** Brian Eckenrode, PT, DPT, MS, OCS

**Purpose:** Knee flexion contractures are a common consequence of injury to the lower extremity. They can result from trauma, inflammation, or immobilization to the knee joint and have an effect on gait and overall function. This case study will describe the physical therapy intervention and functional improvement in a patient with a knee flexion contracture following a tear to the medial gastrocnemius, as well as exhibit the long-term effectiveness of this intervention with continued application after formal physical therapy discharge.

**Case Description:** A 53 year-old female patient presented to outpatient physical therapy with complaints of difficulty navigating stairs and increased discomfort with household activity and ambulation. The patient reported that the discomfort began initially after sustaining a lower extremity injury 9 months ago while biking after her foot slipped off the pedal and caused hyperextension of her knee. MRI and physical examination were consistent with a tear of the right calf muscle, specifically the medial gastrocnemius. Upon the initial evaluation, the patient ambulated with an antalgic gait, and demonstrated a 15-degree right knee flexion contracture. She also exhibited significant strength deficits in both plantarflexors. Physical therapy intervention initially consisted of patient instruction in passive low load, long duration end range stretching to the knee joint. In addition, gastrocnemius stretching, plantarflexor strengthening, and gait training were added to the plan of care.

**Outcome:** The patient was seen for a total of five physical therapy visits. Upon discharge the patient showed a significant increase in function as demonstrated by pre and post scores on the Foot and Ankle Ability Measure (FAAM). The FAAM scores at initial evaluation, discharge and two-month follow up were 66/100, 75/100, and 95/100 respectively. These values show change greater than the Minimal Clinically Important Difference (MCID) of 8/100 points. The patient also demonstrated a change from a 15-degree knee flexion contracture at initial evaluation to a 3-degree knee flexion contracture at discharge.

**Discussion:** This case report illustrates the efficacy of low load, long duration stretching as a mode to increase functional mobility in a patient with a knee flexion contracture. The utilization of conservative physical therapy management with good patient adherence to a home exercise program continued to improve functional mobility even after discharge.



## Feasibility Study on Data Collection of Physical Therapy Interventions Following Total Knee Arthroplasty

**Students:** Kathryn Bogel, Michelle Wilson, Emily Wolf

**Faculty:** Carol Oatis, PT, Ph.D

**Purpose:** Total knee arthroplasty (TKA) is one of the most frequently performed orthopedic procedures in older adults. Previous studies have shown that there is no consensus on best practice physical therapy following TKA, and the care that is provided is highly variable across settings and between therapists. This study analyzes the feasibility of a data collection system to capture current PT practice with patients post TKA and will yield quantitative and qualitative data regarding the willingness of physical therapists to complete the proposed documentation system, the burden of using the documentation system, the thoroughness of the proposed exercise menu, and preliminary data regarding physical therapy practice. Additionally, this study will help to identify any obstacles encountered in recruiting participants.

**Subjects:** 7 student physical therapist/physical therapists from outpatient orthopedic clinics that are a part of the Arcadia University Clinical Education (ACE) network.

**Methods:** Email requests were sent to 16 outpatient physical therapy clinics in the ACE network. If a clinic manager approved the research request, consent forms were forwarded to clinicians. Interested clinicians completed spreadsheets for TKA patients including interventions and intensities of each intervention for every session. Upon completion of the study, participants completed a follow-up survey regarding their experience filling out the spreadsheet.

**Results:** Of the 16 clinics that requests were sent to, 7 clinic managers reported inviting their employees to participate, and forwarding information to the physical therapists and student physical therapists at their organization. 7 clinicians participated in the study, completing a total of 10 spreadsheets with interventions on patients post TKA. 1 clinician saw no patients post TKA during the study, and was therefore excluded from the study. 5 of the 6 participants who completed spreadsheets found it "easy" or "neutral" to complete, however, 3 out of 6 also found it to be "inconvenient." On average, participants reported it took 6 minutes to complete the spreadsheet for each visit.

**Conclusions:** Most participants found the system easy to use, but slightly inconvenient. A few modifications to the data intake spreadsheet, such as copying previous session's exercises, will decrease this time burden for the full-scale study. Notably, the more spreadsheets an individual completed, the less time they reported it took to complete. Further, the list of interventions provided was fairly robust, and only 1 intervention was added, suggesting the list is suitable for the full-scale study. A wide range of interventions were utilized, with a high degree of variability of exercises selected and variability in number of progressions of these exercises.

## Relationship of Muscle Power and Morphology to Function after Hip Fracture

**Students:** Amy Hultzapple, Meara O'Hara, Jessica Watson

**Faculty:** Marty Eastlack, PT, Ph.D; Rebecca Craik, PT, Ph.D, FAPTA; Marc Besser, Ph.D; Kathleen Mangione, PT, Ph.D, FAPTA

**Purpose:** To investigate the relationship among muscle morphology, power, and function in persons post-hip fracture. Goodpaster et al found a negative relationship between muscle fatty infiltration and muscle power in older adults. Also, a positive relationship has been reported between muscle power and preferred gait speed (PGS) in persons post-hip fracture. This study examines the relationships among rectus femoris (RF) morphology, lower extremity (LE) muscle power, sit to stand loading rate (STS), and fast gait speed (FGS) in persons post-hip fracture following completion of a 16-week intervention.

**Subjects:** 11 subjects post hip fracture; 7 females and 4 males; average age=84.9 years old (range=65-95); average time post fracture=8.9 months (range=6-18). The participants are part of a larger study looking at high-intensity strengthening post hip fracture.

**Methods:** Data were collected in one, 2-hour session. Muscle thickness (MT) and muscle quality (MQ) of the RF were assessed using ultrasound (US) (GE LOGIQ e™). US images were analyzed using Image J software for MT (cm) and echo intensity for MQ (grayscale, AU). STS loading rate was measured separately for involved and uninvolved limbs using two force plates (Bertec). Unilateral leg press power was assessed using isokinetic dynamometry (Primus RSTM, BTE). FGS was assessed using the GaitMat II™. Analysis consisted of Pearson correlations and linear regressions.

**Results:** Involved limb power was negatively correlated with involved RF MQ ( $r=-0.86$ ). Uninvolved and involved power were highly correlated to MT in either limb, uninvolved STS ( $r=0.96$  and  $0.94$ , respectively) and to FGS ( $r=0.77$  and  $0.71$ , respectively). MT in either limb was correlated with STS with a higher correlation for the involved limb ( $r=0.94$ ). Involved MT was correlated to FGS ( $r=0.70$ ).

**Conclusion:** Lower extremity power of the uninvolved limb is the main determinant of STS and FGS, accounting for 90% and 55% of the variance, but muscle morphology of the involved limb also correlated with STS and FGS. We suggest that the involved limb plays a pivotal role in function, too. Similar findings were reported by Portegijs in women post hip fracture where lower LE power of the uninvolved side was associated with slower preferred gait speed and stair climbing time. Increased fatty infiltration of the involved RF led to decreased power, which was similar to a previous finding reported by Goodpaster. Our results suggest that performance differences between limbs persist following hip fracture and rehabilitation. The between-limb differences can affect functional symmetry and walking performance.

## Can Heart Rate Monitors Be Used To Monitor Treatment Fidelity?

**Student:** Shane Harris

**Faculty:** Kathleen Mangione, PT, Ph.D, FAPTA

**Co-investigators:** K. Macropol, Ph.D, Y. Jia, Ph.D, N. Wolff, Ph.D;  
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**Introduction:** Treatment fidelity is ongoing assessment, monitoring, and enhancement of “how well was the intervention delivered” thus informing the reliability and validity of a study. Options for assessment of treatment delivery are costly and intrusive, or too subjective. More objective evaluation of intervention fidelity is needed. Heart rate (HR) is a commonly reported measure of exercise intensity in rehabilitation research, but there is limited evidence on its use to monitor treatment fidelity. Heart rate allows for objective measurement of physiologic stress, but there are incorrect HR recordings due to external and internal factors.

**Purpose:** This study describes common HR errors observed during exercise training in older adults, frequency of errors, and whether there is clinically meaningful benefit to data correction via computer programming.

**Methods:** Heart rate data were collected using Polar monitors amongst two groups of post-hip fracture patients undergoing a multi-component exercise program. HR by time curves (n=620) were examined and rules were created to determine whether the data presented on the HR curves were true physiologic data or non-physiologic artifacts. A subset of the HR curves from treatment sessions was given to four different raters: the principal investigator was considered gold standard, and the other three were considered experts in exercise and HR responses. Sensitivity, specificity, and accuracy were derived from analysis to represent concurrent validity of identifying artifacts in the HR curves. The rules were written and new HR averages were obtained after data correction. The computer-generated rules were compared to one of the experts and validity statistics were performed again. Lastly, the rules were applied to a new sample of exercise sessions (n=1353) to determine whether the rules were generalizable.

**Results:** Accuracy statistics were 99% with the first rater, 99.5% with the second rater, and 94.4% with the third rater. There was 91.2% agreement between the expert rater and the computer. The corrected HR values were not considered clinically important.

**Discussion:** The sample size for this study was very large, with over one thousand exercise sessions. Although we had validated indicators of physiologic and non-physiologic data from experts, the correction process did not change the average heart rates in a meaningful way. While there was less agreement between the expert and computer, the program can be modified further to increase agreement.

**Conclusion:** The cost and convenience of using commercial equipment for measuring HR during exercise makes this measure a useful one for measuring treatment fidelity in an exercise trial.

## Effects of Manual, Instrument, and Electrical Stimulation Interventions on Myofascial Trigger Points in the Upper Quarter

**Students:** Stacey Gorter, Irmina Niebylska, Emily Thompson

**Faculty:** Scott Stackhouse, PT, Ph.D; Brian Eckenrode, PT, DPT, MS, OCS

**Purpose:** Myofascial trigger points (MTrPs) are a common clinical problem and have been linked to peripheral and central nervous system sensitization. There are few studies that compare the effects of different interventions on decreasing pain sensitivity of MTrPs of the upper trapezius (UT) and levator scapulae (LS), and no controlled studies investigating the effects of instrument-assisted soft tissue mobilization (IASTM) on MTrPs. This study was conducted to assess the effects of two forms of electrical stimulation (e-stim), ischemic compression, and IASTM on pain sensitivity.

**Methods:** 52 people were recruited; 39 qualified after screening and were block randomized by sex into one of 5 treatment groups. Sensory testing was performed to determine pressure pain threshold (PPT), heat pain threshold (HPT), and heat temporal summation (HTS) to regions of the upper quarter innervated by C4, C5, & C6. Sensory testing occurred at 3 time points: pre-treatment, immediately post-treatment, and the following morning. C4 was assessed at the MTrP, C5 at the acromion process, and C6 at the thenar eminence. After a 5 min break, an intervention was provided: high frequency motor-level e-stim (HFES; n = 7), low frequency motor-level e-stim (LFES; n = 9), instrument assisted soft tissue mobilization (IASTM; n = 9), manual ischemic compression (IC; n = 9), or control of sensory-threshold e-stim (n = 5). Preliminary analysis using mean differences with 95% confidence intervals and effects sizes was performed as data collection is ongoing.

**Results:** PPT changed moderately with HFES and IC. Increases in PPT for HFES posttreatment at C5 = 0.53kg (95%CI = 0.11 to 0.95;  $\delta$  = 0.93), C6 = 0.96kg (95%CI = 0.0 to 1.92;  $\delta$  = 0.76), and next day at C6 = 1.07kg (95%CI = 0.25 to 1.89;  $\delta$  = 1.01). IC showed an increase in PPT post-treatment at C5 = 0.90kg (95%CI = 0.17 to 1.63;  $\delta$  = 0.80). HPT changed more broadly by the interventions (LFES, IC, IASTM, HFES) but particularly for LFES post-treatment at C4 = 1.57°C (95%CI = 0.2 to 2.94;  $\delta$  = 0.75) and C6 = 0.91°C (95%CI = 0.39 to 1.43;  $\delta$  = 1.13) with similar effects at these two sites the next morning. HTS changed moderately with HFES and IASTM. Decreases in HTS were seen for HFES the next morning = -11.37mm (95%CI = 0.09 to 22.65;  $\delta$  = -0.81) and for IASTM post-treatment = 10.11mm (95%CI = 1.22 to 19;  $\delta$  = -0.74).

**Discussion:** Findings indicate that HFES and IC may have broader effects across multiple pain sensitivity measurements and effects may persist the next day. Final sample size estimates will be calculated to appropriately power this study. Although treatment of MTrPs should not be the sole focus of a treatment plan, this study aims to provide information about immediate and next day effects on pain sensitivity measures.

## International Interprofessional Education Experience: Ambergris Caye, Belize

**Students:** Samantha Rooney, Michelle Wilson

**Faculty:** Karen Sawyer, PT, DPT, MA; Kristin von Nieda, PT, M.Ed, DPT; Ann Tokay Harrington, PT, DPT, Ph.D, PCS; Amy Miller, PT, DPT, Ed.D

**Purpose:** International Interprofessional Education Experience (I<sup>2</sup>PE<sup>2</sup>) provides the opportunity for individuals to promote, respect, and practice collaboratively with other departments and specialties. It is a way for students to learn with and from their peers in other professional programs to gain a better understanding of different professions. I<sup>2</sup>PE<sup>2</sup> also helps students understand the importance of collaborative practice in life after graduation. This trip had three goals of partnership, program, and pro-bono services. Ambergris Caye (AC), Belize was chosen for this trip because of the high incidence of chronic diseases, lack of healthcare outside of a 24 hour PolyClinic, no access to physical therapy, and limited services for children with special needs.

**Methods:** Students and professionals across the interdisciplinary team worked in small groups to provide services to Belizeans for two weeks in AC, Belize. The team included: physical therapy (PT), genetic counseling, public health, physician assistant, special education, and counseling. Each discipline acted in a “primary,” “secondary,” or a “listener/learner” role during sessions, allowing the team to work within their strengths while teaching others and learning from teammates. Data were collected with “Listener and Learner” sheets filled out by both the students and professionals. Sessions in which the PT department acted in the “primary” role included home visits for pediatric and adult neurological or orthopedic conditions. Students completed surveys pre- and post-trip: Interprofessional Attitudes Scale; Interprofessional Educational Survey (IPES) and Interprofessional Educational Competency; to assess the effects of the interprofessional trip.

**Results:** The experience was summarized by PT students as “one of the most amazing experiences...” “an amazing mix of slight discomfort yet being at ease because you felt so supported.” The Learning Fair hosted by the interdisciplinary team provided health education and care to 140 Belizeans. During the two weeks of home visits, the PT team visited to over 20 Belizeans providing necessary evaluations, functional training, caregiver education and exercises. Initial analysis of the IPES demonstrated an increase in accuracy and richness from pre- to post-trip; a glimpse into the success of this I<sup>2</sup>PE<sup>2</sup>.

**Discussion/Conclusion:** Each student completed a reflection paper emphasizing the “highs,” “lows” and recommendations for future I<sup>2</sup>PE<sup>2</sup> trips. Analysis of the surveys will be completed by the professionals to further assist with planning future experiences. The PT Department plans to modify future trips by adding a “walk-in” clinic to address more basic orthopedic conditions. Future I<sup>2</sup>PE<sup>2</sup> may also be planned to provide services for other countries in need.

## Best Practice Assessment and Interventions for Patients with Wounds in a Home Health Setting

**Students:** Mitchell Brotsky, Kira D’Annunzio, Kyle Suydam

**Faculty:** Tony D’Alonzo, PT, DPT, MBA

**Purpose:** There is mixed evidence on the superiority of eccentric-only exercise in reducing pain in chronic tendinopathies. The purpose of this study was to investigate the effects of plantarflexion exercise (eccentric, concentric, or isometric) on pain sensitivity measures over the Achilles tendon. We hypothesized that there will be no between-group differences in the effects on pain sensitivity when contraction duration is equivalent across groups.

**Subjects:** To date, 58 adults were screened and 33 were found eligible (age=25.0; SD=2.7) and block-randomized by sex into eccentric(ECC), concentric(CON), or isometric(ISO) groups.

**Methods:** After eligibility screening and consent, subjects completed a series of questionnaires on pain and anxiety. Participants had their dominant side Achilles tendon assessed for pressure pain threshold (PPT), heat pain threshold (HPT), and heat temporal summation (HTS). The study timeline was as follows: Baseline 1, 48-hr washout, Baseline 2, 1-week intervention, and next day Post-intervention assessment. After the Baseline 2 assessment, participants were instructed in specific exercise according to group assignment: CON, ECC, or ISO plantarflexion contractions. One investigator observed and gave feedback during their first 3 sets of 15 reps of exercise. All contraction durations were to last 5 sec and subjects were asked to complete 3 sets of 15 reps 2x/day for 7 days.

**Results:** There were no differences between groups on pain and anxiety questionnaires and for exercise compliance ( $p > 0.05$ ). Excluded participants were mostly male due to not meeting a HPT of  $\leq 46.5^{\circ}\text{C}$ . Sex breakdown per group was: CON-8 female, 3 male; ECC-8 female, 3 male; ISO-8 female, 2 male. Preliminary analysis was performed by calculating absolute and standardized effects sizes of the change scores (post-intervention minus the average baseline) for PPT, HPT, and HTS. HPT increased in CON by  $2.31^{\circ}\text{C}$  (95%CI=1.41 to 3.20;  $\delta=1.22$ ), ECC by  $1.45^{\circ}\text{C}$  (95%CI=0.64 to 2.37;  $\delta=0.79$ ), and ISO by  $2.34^{\circ}\text{C}$  (95%CI=1.51 to 3.18;  $\delta=1.07$ ). HTS decreased in CON by 9.03mm (95%CI=3.58 to -21.65;  $\delta=-0.50$ ), ECC by 12.18mm (95%CI=-2.42 to -21.94;  $\delta=-0.89$ ), and ISO by 7.40mm (95%CI=-1.12 to -13.68;  $\delta=-0.35$ ). There was no consistent change in PPT across groups although the ECC group had an increased PPT of 1.14kg (95%CI=-0.82 to 3.09;  $\delta=0.34$ ). Data collection will continue to include 10 females and males in each treatment group as per prior sample size estimate.

**Conclusions:** Preliminarily, all exercise groups similarly reduced pain sensitivity for HPT and HTS when contraction durations were equivalent. Additionally, eccentric exercise may decrease sensitivity to PPT. Future direction would include study of pain sensitivity in people with Achilles tendinopathy.

Contraction duration, not contraction type, may be an important variable that imparts hypoalgesic effects in people with chronic tendinopathies.



## Perceptions of the Curriculum: The Arcadia Experience

**Students:** Rebecca Dobson, Caitlin Forgione, Eric Pang

**Faculty:** Laurita Hack, PT, Ph.D, MBA, FAPTA; Amy Miller, PT, DPT, Ed.D.

**Purpose:** Arcadia University's physical therapist education curriculum is an evolving integrative curriculum created during the program's shift from a master's to a doctoral degree. The curriculum was designed to give students the ability to have the basic knowledge and skills of physical therapy within the first year of the program and have a framework for management of every major patient type after the second year of the program. This study was designed to assess whether student perceptions about the curriculum aligned with the mission statement, faculty's intent for the curriculum and the nine stated goals of Arcadia's DPT program.

**Methods:** A qualitative grounded theory approach was used, a preliminary framework was developed and used to develop standard interview schedules. In-depth interviews were conducted with fifteen randomized participants, five from each of the three classes, regarding their opinions, thoughts, and perspectives of Arcadia University's curriculum. The data from the interviews were coded, using researcher checks to assure consistency and resultant themes were identified.

**Results:** A resultant conceptual framework was developed, consisting of three main concepts: structure, process, and outcome. Themes were identified in each of these concepts. Structure: curricular structure, faculty; Process: diversity in learning experience, emphasis on repetition and recall of material, learning within clinical education, integration of various subject content, taking a team approach, gaining a deeper understanding of previous knowledge, change in study time, change in organization of material; Outcomes: evidence based practice, a patient centered approach, and professional formation. These themes support the intended goals and mission of the program, however, many of the goals of the program were not mentioned in the data.

**Discussion/Conclusion:** This study aimed to determine whether student perceptions of the curriculum matched the intended goals of the program. The data show that the original goal of developing a learner centered curriculum has been met. Faculty can use the data collected from this research to

- further assess the curriculum and determine what goals of the program the students have perceived as important concepts presented throughout their time in the graduate program.,
- identify program goals that students did not perceive as important and aim to make these goals more explicit and integrated within the program.

It also should be acknowledged that some goals may be explicitly integrated within the program and our chosen questions for the interviews may not have elicited responses regarding these topics. It would also be beneficial if the program separated the intended goals of students versus faculty to make it clearer what was expected of students more and what was expected of faculty more.

## Physical Activity Participation and Enjoyment in Children with Down Syndrome

**Students:** Nina Gallelli, Emily Kerley, Samantha Rooney

**Faculty:** Ann Tokay Harrington, PT, DPT, Ph.D, PCS

**Purpose:** Obesity, specifically childhood obesity, is a rising epidemic. Children with Down Syndrome (DS) have an increased risk of obesity and secondary complications including high blood pressure, type 2 diabetes and sleep apnea. Children with disabilities or intellectual disability, such as DS, face additional barriers to physical activity participation including personal, social, environmental and policy/program-related. The purpose of this project was to determine differences in activity participation and enjoyment between males and females with DS, age 6-19 years.

**Methods:** Participants were recruited through the Trisomy 21 clinic at Children's Hospital of Philadelphia, local community groups and local therapists. Participants completed a 60-90 minute interview and survey with the study investigators. Following consent procedures, a brief questionnaire about demographics and physical activity was completed followed by administration of the Children's Assessment of Participation and Enjoyment (CAPE) and Preferences for Activities of Children (PAC). A parent was present to assist as needed and confirm any responses for which the participation was uncertain. Wilcoxon-signed rank test was used to examine differences between male and female participants and younger (6-10 years old) and older (12-19) groups.

**Results:** Fourteen participants completed the study (7 male) with a mean age of 12.5 years (SD 4.3 years). All participants were included in CAPE analysis and 12 had complete PAC data. Not all subjects were able to complete the PAC portion of testing, as this requires participant response on preferred activities without parental influence. No significant differences were detected between the female and male participants for CAPE dimensions (Diversity of activity, Intensity of activity, With whom they participate, Where they participate, and Enjoyment) nor for Overall PAC score. Additionally, no age-based differences were detected for any of the dimensions above.

**Discussion/Conclusion:** Children with disabilities participate in less recreational physical activity than, both organized and independent, compared to children without disabilities. In children and teenagers without disability, females demonstrate less participation in physical activities despite Title IX instatement in 1972. We hypothesized a lower level of participation in females with DS compared to male counterparts based on the literature, however, in this study there are no significant differences between genders across the dimensions of physical activity. Current limitations of this study include small sample size and limited age distribution of participants, but data collection is ongoing. Study of enjoyment and participation in individuals with DS may allow clinicians to develop more effective intervention programs for this population.

## The Effects of a Week-Long Intensive Stroke Camp on Outcomes in Patients with Chronic Stroke

**Students:** Rachel Jordan, Andrew Nauss, Gabriel Rocco

**Faculty:** Shailesh Kantak, PT, Ph.D; Karen Sawyer, PT, DPT, MA

**Purpose:** It is well known that in neurorehabilitation after a CVA, appropriate repetition and intensity of functional training are necessary to achieve a meaningful response to therapy. However, the research has not reached a consensus for ideal dosage for gait training, nor which patients will respond to a high intensity intervention focused on ambulation.

**Methods:** 65 patients participated in an intensive, week long camp that focused on motor learning principles for rehabilitation of upper and lower extremities. Only 60 of these patients had pre- and post- data for gait speed via the 10MWT. This analysis focuses on the effects of lower extremity training on gait speed, and attempts to determine which patient group showed the largest improvement.

**Results:** These 60 subjects improved an average of 0.18 m/s, which is greater than the MCID for gait speed (0.16 m/s). However, the changes in gait speed were not equal across groups, categorized by pre-intervention gait speed (household ambulators (<0.4 m/s); limited community ambulators (0.4-0.8 m/s); community ambulators (>0.8 m/s)) (ANOVA:  $F=6.715$ ,  $p=.0024$ ). Post hoc pairwise t-tests were also conducted, and a significant difference was found for household ambulators x community ambulators ( $t=-3.58$ ,  $p < 0.001$ ). The number in each category passing MCID (0.16 m/s) was also analyzed, finding no difference in household ambulators x limited community ambulators, and no difference in limited community ambulators x community ambulators; however, there was a statistical difference between household ambulators and community ambulators ( $X^2=4.737$ ;  $p=0.0295$ ).

**Conclusion:** This analysis shows that an intensive week-long therapeutic camp can provide clinically important improvements in gait speed in patients after stroke, and has a greater effect on those patients with an initial gait speed greater than 0.8 m/s than those patients with gait speed less than 0.4 m/s.

## Reliability of Ultrasound Measurements of Rotator Cuff Muscle Cross-Sectional Area in Healthy Adults

**Students:** Matthew Brennan, Joseph Bucantis, Erik Kust, Jonathan Washatka

**Faculty:** Philip McClure, PT, Ph.D, FAPTA; Kshamata Shah, PT, DPT, Ph.D

**Purpose:** Muscle atrophy has been reported in patients with rotator cuff pathology. Presumably, exercise yields positive changes in muscle structure which may be associated with improved strength and function, though this has not been well-studied. Ultrasound (US) imaging has been used extensively for examining shoulder pathology. However, reliability of shoulder muscle size measurement with US is not well established. A few studies have reported variable reliability, 0.45-0.88, of rotator cuff muscle size using US. Further, the relationship between muscle cross-sectional area (CSA) and torque measures is not known. The aim of this study was to establish the reliability of shoulder muscle size using US, examine side-to-side differences and to determine the relationship between size and torque.

**Number of Subjects:** 19 asymptomatic, healthy adults (mean age 30.8 years (11.8); 12M/7F).

**Materials & Methods:** Supraspinatus and infraspinatus muscle size of both shoulders was obtained using US. Multiple scans were performed a mean of 1.9 days apart. Supraspinatus images were captured in the transverse view at the suprascapular notch identified with the US with subject in a seated position and arm resting on a pillow. The infraspinatus muscle CSA was determined with subject in prone position. Using bony landmarks and a custom-made template to standardize the measurement location, serial images of the muscle were obtained and spliced to calculate the CSA. Three scans were performed at each session and averaged. Size measurements (cm<sup>2</sup>) were then performed using ImageJ analysis. Abduction and external rotation torque (normalized to body weight) was calculated using force measures from a hand-held dynamometer and moment arm length.

**Results:** The ICC, SEM and MDC values for the between-session reliability for muscle size measurements were as follows: supraspinatus ICC 0.97 (0.93-0.99, 95%CI) SEM 0.3, MDC<sub>95</sub> 0.8 and infraspinatus ICC 0.95 (0.86-0.98, 95% CI), SEM 1.3, MDC<sub>95</sub> 3.1. The mean CSA for supraspinatus and infraspinatus for the right arm (7.3 (1.7) and 16.5 (5.7)) were not different,  $p>0.05$ , from the left arm (6.9 (1.5) and 14.3 (5.5)). The abduction torque and external rotation torque were not strongly related to the muscle size measurements (range of r values = 0.18 to 0.37).

**Conclusions:** The results of this study show excellent reliability for supraspinatus and infraspinatus muscle CSA measurements. Since there was no difference between the muscle CSA between sides, the contralateral arm measures may be used as an "index". Correlation between muscle size and torque was not strong. Future steps include examining the change in muscle size in response to an exercise program.



## The Effects of Eccentric, Concentric, and Isometric Contractions on Pain Sensitivity over the Achilles Tendon

**Students:** Kaitlyn Colagreco, Elizabeth Michel, Joshua Tizzard

**Faculty:** Scott Stackhouse, PT, Ph.D; Brian Eckenrode, PT, DPT, MS, OCS

**Purpose:** There is mixed evidence for the superiority of eccentric-only exercise in reducing pain in chronic tendinopathies. The purpose of this study was to investigate the effects of plantarflexion exercise (eccentric, concentric, or isometric) on pain sensitivity measures over the Achilles tendon. We hypothesized that there will be no between-group differences in the effects on pain sensitivity when contraction duration is equivalent across groups.

**Subjects:** Sixty-nine adults were screened and 42 were found eligible (age=24.6; SD=2.8) and block-randomized by sex into eccentric(ECC), concentric(CON), or isometric(ISOM) groups.

**Methods:** After eligibility screening and consent, subjects completed a series of questionnaires on pain and anxiety. Participants had their dominant side Achilles tendon assessed for pressure pain threshold (PPT) with an algometer, and heat pain threshold (HPT) and heat temporal summation (HTS) assessed with a computer-controlled thermode. The study timeline was as follows: Baseline 1, 48-hr washout, Baseline 2, 1-week intervention, and next day Post-intervention assessment. After the Baseline 2 assessment, participants were instructed in specific exercise according to group assignment: CON, ECC, or ISOM plantarflexion contractions. One investigator observed and gave feedback during their first 3 sets of 15 reps of exercise. All contraction durations were to last 5 sec and subjects were asked to complete 3 sets of 15 reps 2x/day for 7 days.

**Results:** There were no differences between groups on pain and anxiety questionnaires and for exercise compliance ( $p > 0.05$ ). Excluded participants were mostly male due to not meeting a HPT of  $\leq 46.5^\circ\text{C}$ . Sex breakdown per group was: CON-8 female, 6 male; ECC-8 female, 5 male; ISOM-8 female, 6 male. Preliminary analysis was performed by calculating absolute and standardized effects sizes of the change scores (post-intervention minus the average baseline) for PPT, HPT, and HTS. HPT increased in CON by  $2.01^\circ\text{C}$  (95%CI = 1.18 to 2.83;  $d = 1.06$ ), ECC by  $1.39^\circ\text{C}$  (95%CI = 0.60 to 2.19;  $d = 0.79$ ), and ISOM by  $2.45^\circ\text{C}$  (95%CI = 1.39 to 3.51;  $d = 1.17$ ). HTS decreased in CON by 7.21mm (95%CI = 3.97 to -18.40;  $d = -0.42$ ), ECC by 12.50mm (95%CI = -3.65 to -21.35;  $d = -0.9$ ), and ISOM by 7.39mm (95%CI = -2.22 to -12.56;  $d = -0.33$ ). There was no consistent change in PPT across groups. Data collection will continue to include 10 females and males in each treatment group as per prior sample size estimate.

**Conclusions:** Preliminary analysis showed that after one week of exercise, all treatment groups similarly reduced pain sensitivity for HPT, and ISOM and ECC groups also reduced HTS consistently. The changes observed in pain sensitivity support the use of long (5sec) duration contractions to create hypoalgesia and de-emphasize contraction type.

## Differences Between Dynamic Functional Testing and Pressure Pain Threshold Values in Female Distance Runners With and Without a Prior Injury History Presentation

**Students:** Tara Chadwick, Justin Gardner, Lauren Nederostek

**Faculty:** Brian Eckenrode, PT, DPT, MS, OCS

**Purpose:** A prior injury history and being female has been shown to be associated with an increased risk for sustaining a running-related injury (RRI). These overuse injuries can frequently recur or become chronic. Muscle weakness, temporal parameters, and altered biomechanics have been described as potential contributors to RRIs. Recently theorized, individuals with greater localized hyperalgesia from chronic lower extremity conditions may also exhibit altered lower extremity mechanics from increased nociceptive input. The purpose of this pilot study was to investigate differences between dynamic functional testing and pressure pain threshold (PPT) values in female distance runners with and without a prior injury history.

**Methods:** Sixteen female runners, mean age  $23 \pm 3.4$  years, who reported running for a mean  $7.11 \pm 3.74$  years at an average of  $18.89 \pm 9.40$  miles per week met inclusion criteria. A running activity and injury questionnaire, Pain Catastrophizing Scale, and Lower Extremity Functional scale was completed by all subjects prior to testing. Functional performance testing was assessed via the Y-Balance Test (YBT), and PPT was quantified at six different lower extremity sites bilaterally with a digital pressure algometer.

**Results:** Of the 16 subjects, 8 had reported a prior history of lower extremity injury requiring time off from running and medical treatment. No significant differences were found between prior injury history and running pace, running volume, or years running. There was a significant difference for runners with an injury history to have a greater than 4cm side to side difference on the YBT ( $P = 0.009$ ), in addition to a significant difference for YBT absolute difference between extremities ( $P = .030$ ). For PPT, no significant difference in pain threshold values between groups was found. There was a fair to moderate correlation (ICC range, 0.46 - 0.62) between YBT composite score and PPT at both the distal tibia and patella retinaculum in this group of runners.

**Discussion:** Female runners with a prior history of lower extremity injury exhibited greater asymmetry with dynamic functional testing compared to the uninjured group. While no significant differences were found between groups for PPT values in the lower extremity, there was a fair to moderate association between YBT scores and PPT of the distal tibia and patella retinaculum. Further investigations should expand on the relationship between lower extremity functional performance and running mechanics on PPT.

## Feasibility and Benefits of a Brief, Intense Exercise Program Targeting Balance, Gait, Endurance and Upper Extremity Function in Persons with Parkinson Disease: A Case Series

**Students:** Matthew Frawley, Amy Gabriel, Katie Laine, Troy McClanahan, Nathalie Musey, and Michael Stecz

**Faculty:** Janet Readinger PT, DPT; Kristin von Nieda PT, DPT, MED; Marty Eastlack PT, Ph.D; Karen Sawyer PT, DPT, MA

**Purpose:** Individuals with Parkinson Disease(PD) have safely completed three trials of a week-long high intensity exercise program, Movement Camp(MC), which is offered on a yearly basis. MC 2014 focused on examining the effects of a brief, high-intensity exercise program in individuals with PD. MC 2015 had a similar focus, but included a greater sample size and greater range of disease severity. The purpose of MC 2016 was to continue to examine the feasibility and benefits of a brief, high-intensity week-long exercise program for individuals with PD and detail outcomes for individuals who participated in multiple MCs.

**Methods:** Eight individuals with PD participated in MC 2016, two of whom participated in MC 2014 and 2015, one who participated in MC 2014, and five first-time participants. In total, 15 first-time participants completed MC over the three years. The camp consisted of 5.5 hours of exercise daily: 1.5 hours of group exercise and 4 hours of balance/agility, endurance, upper extremity, and functional gait activities. All interventions were evidence based and designed to address common impairments of individuals with PD. Outcome measures included: 6 Minute Walk Test (6MWT), Mini-BESTest, Unified Parkinson Disease Rating Scale (UPDRS), Five Times Sit to Stand (5xSTS), Gait Speed 10-meter Walk Test (fast and slow), Physical Performance Test, Seated Trunk Rotation Test, Activities-specific Balance Confidence Scale and Parkinson Disease Questionnaire.

**Results:** Improvements were noted in 6MWT, Mini-BESTest, UPDRS, 5xSTS, and fast gait speed immediately after completion of MC 2016. When analyzing the data from the past three MCs, the greatest improvement was seen in the Mini-BESTest as 6/15 participants maintained changes greater than the minimal detectable change (MDC) at immediate post-testing and 6-week follow up. In immediate post testing improvements were noted in, 15/15 participants on the 6MWT and Mini-BESTest (6/15 met MDC), 11/15 on the UPDRS (3/15 met MDC), and 9/15 on the 5xSTS and fast gait speed (3/15 met MDC for each).

**Conclusion:** All participants successfully completed the week-long, high-intensity exercise program without complication. Most participants made positive gains immediately following MC 2016. Some gains were maintained at 6 week post testing. The results from this study suggest that a week-long, high-intensity exercise program for individuals with PD is feasible and demonstrates positive benefits in functional mobility. A randomized control trial is needed to validate this model and develop precise exercise parameters.

## Supraspinatus Structural Changes Observed with Ultrasound Imaging in Painful Adult Swimmers

**Students:** Alyssa Peterson, Anthony Blubello, David Blum, Justin Cobb

**Faculty:** Angela Tate PT, DPT, Ph.D; Stephen Thomas, Ph.D, ATC; Joseph Sarver Ph.D, MS

**Purpose:** Supraspinatus tendinopathy and shoulder pain are common in youth swimmers but no studies have investigated pain prevalence in adult swimmers and efficiently imaged their supraspinatus tendons to determine if there are structural changes associated with shoulder pain. The purposes of this study were to determine: 1) The prevalence of shoulder pain and disability in adult swimmers, 2) If physical measures and training volume vary between those with and without shoulder pain and disability, and 3) If tendon structure differences exist between painful and non-painful shoulders.

**Subjects:** 20 male and 19 female swimmers, mean age 47 years from 3 adult teams

**Methods:** Swimmers completed a survey of demographics, training volume, pain rating using the Penn Shoulder Score and disability using the Disability of Arm Shoulder Hand sports module. They underwent a physical exam including shoulder ROM, the Posterior Shoulder Endurance Test and diagnostic ultrasound (US) imaging. The banding pattern in these images was analyzed using custom software to quantify tissue organization, and a t-test was used to compare images of swimmers with high and low pain ratings. Independent t-tests were used to compare examination findings between those with significant pain and disability (+PD) and those without (-PD).

**Results:** 15% of subjects reported pain at rest, 28% with normal ADLs, and 69% with sports. 50% reported disability. Swimmer's age, BMI, posterior shoulder endurance, hours trained/week, and years swam did not vary between the +PD and -PD groups. However, the +PD group had 10 degrees less shoulder IR ( $p=.009$ ), 8 degrees less ER ( $p=.02$ ), and completed less yardage per day ( $p=.04$ ) and per year ( $p=.026$ ). There were significant differences in supraspinatus banding patterns between the high and low pain groups.

**Conclusions:** Adults incur a high prevalence of shoulder pain and disability. Unlike youths, adults with pain and disability swim less yardage, perhaps due to self-imposed limitations or they may lack the physical conditioning for the repetitive training. The reduced shoulder motion found in the +PD group may be due to structural changes from overuse predisposing swimmers to pain. Specifically, the high pain group was found to have significantly less organized supraspinatus tendon, as measured by our analysis of the banding pattern in the US images. Prospective studies are needed to determine if yardage and ROM differences are predisposing factors to shoulder pain.

**Discussion:** Given its inexpensive and portable nature, US imaging has the potential to screen swimmers for decreases in tendon organization shown to precede tears and monitor structural responses to loading to identify optimal training parameters to reduce shoulder pain.

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## Clinical Education Sites

*We are grateful for the support of the following facilities who participated in the clinical education of the PT Class of 2017.*

Abington Health Lansdale Hospital  
 Abington Memorial Hospital  
 Advanced Manual Therapy & Sports Rehabilitation  
 Allied Health  
 Aria Health  
 ATI Physical Therapy  
 Austill's Rehabilitation Services  
 Bacharach Institute for Rehabilitation  
 Bancroft NeuroRehab  
 Barnegat Sports Rehabilitation & Physical Therapy  
 BREAKTHRU Fitness and Physical Therapy  
 Brooks Center for Sports Therapy  
 Bryn Mawr Rehab Hospital  
 Bucks Physical Therapy and Sports Rehab  
 Capital Health System  
 Central PA Rehabilitation Services  
 Chestnut Hill Hospital  
 Children's Development Center  
 Children's Hospital of Philadelphia  
 Concentra Medical Center  
 Conshohocken Physical Therapy  
 Drescher Physical Therapy  
 E & A Therapy Inc.  
 Easter Seals  
 Einstein Medical Center  
 Foulkeways at Gwynedd  
 Fox Rehabilitation  
 Genesis  
 Good Shepherd Physical Therapy  
 Good Shepherd Rehab Hospital  
 GSPP Penn Institute for Rehab Medicine  
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 Hand & Ortho Physical Therapy Associates  
 Hartz Physical Therapy  
 Holy Redeemer Hospital & Medical Center  
 Holy Spirit Hospital System

## Clinical Education Sites

*We are grateful for the support of the following facilities who participated in the clinical education of the PT Class of 2017.*

Intermountain Medical Center  
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Lancaster General Hospital  
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Lehigh Valley Health Network  
M & M Physical Therapy  
Magee Rehabilitation Hospital  
Mercy Health System  
MossRehab Hospitals  
MossRehab Outpatient Centers  
Nazareth Hospital  
NovaCare Rehabilitation  
OhioHealth MedCentral Shelby Hospital  
Penn Care at Home & Hospice Services  
Portneuf Medical Center  
Reading Health Rehabilitation Hospital  
Results Physiotherapy  
Rusk Rehabilitation at NYU Langone Medical Center  
Select Physical Therapy  
Sharp Memorial Hospital  
St. Barnabas Medical Center  
St. Christopher's Hospital for Children  
St. Lawrence Rehabilitation  
St. Luke's Physical Therapy  
St. Mary's Medical Center- Langhorne, PA  
St. Mary's Medical Center- Evansville, IN  
Strive Physical Therapy & Sports Rehab  
Temple University Hospital  
The Children's Institute  
The Reading Hospital at Wyomissing Plaza  
Theraplay  
Three Dimensional Physical Therapy  
Valley Health (Winchester Medical)  
Veterans Affairs Palo Alto Health Care System  
West Oak Lane  
Willow Grove Physical Therapy

## Notes

## Notes



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