2019 / volume 31 / number 1

ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The magazine of the Academy of Orthopaedic Physical Therapy, APTA

FEATURE:

Effect of Eccentric Exercises at the Knee with Hip Muscle Strengthening to Treat Patellar Tendinopathy in Active Duty Military Personnel

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ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The magazine of the Academy of Orthopaedic Physical Therapy, APTA

In this issue

Regular features

OPTP Mission

To serve as an advocate and resource for the practice of Orthopaedic Physical Therapy by fostering quality patient/client care and promoting professional growth.

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2019 / volume 31 / number 1

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Explore all the indepdendent study courses (ISCs) we have to offer at: orthopt.org

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President's Corner

All Good Things Must Come to an End

It is hard to believe that 6 years of service as your President has now come to the end. Thank you for allowing me to serve you! I want to take this opportunity to share with you what WE have accomplished.

When elected in 2013, I came to the Orthopaedic Section now Academy of Orthopaedic Physical Therapy (AOPT) with one basic philosophy. This leadership opportunity granted to me by the members would not be about my personal accomplishments. It would be about me facilitating and enabling volunteer experts to actively participate in the achievement of the mission and vision of the Academy. I appreciate that as President, leading and developing teambuilding is certainly important but sometimes driving the bus just plainly means taking a backseat. Within that viewpoint I basically believed that my position was to lead with a collaborative philosophy, absent of personal agendas with openness of bias and to follow with collective actions that would excel the Academy in practice, education, research, and advocacy. Such initiatives were always framed by integrity, professionalism, and orthopaedic clinical science. My goal then as I saw it was to facilitate opportunities for members to participate in the dynamic development and enhancement of the AOPT. I feel that goal was accomplished across all our outcomes. I deeply and sincerely thank all of you who have taken any opportunity to serve, for your personal dedication, sacrifices, and compromises on behalf of the AOPT.

So, what have WE accomplished in the past 6 years? Here's a sample of some of the many initiatives and actions:

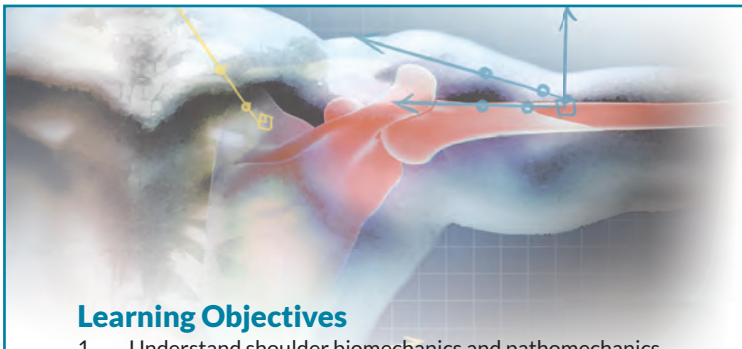
- Annual Orthopaedic Meeting (AOM):
  - Advanced the development of AOM in accordance with the members needs and feedback. This included restructuring the meeting and the topics within the meetings.
  - Adapted and modified our advanced clinical meeting philosophy by including students and physical therapist assistants in accordance with their competencies.
  - Added an AOM Director whose objective is help orchestrate and coordinate the annual meeting with independent study courses, content experts, and our other educational programming.
- Publications:
  - Restructured and reorganized the framing of the ISC and *OP* editors' contracts, responsibilities, and accountabilities.
  - Managed and coordinated the development of the Independent Study Courses platform with *JOSPT* which has now further advanced to our own Learning Management System.
- Clinical Practice Guidelines:
  - Reorganized and restructured the oversight of clinical practice guidelines including the development of new guidelines, revising guidelines, and implementation of guideline products.
  - Executed an ICF-based CPG coordinator.
  - Facilitated the development, design, and coordination of Clinical Practice Guidelines into the structuring of modules for the APTA Physical Therapy Registry.
- Board of Directors Functionality:
  - Enhanced the Board of Directors orientation program. This includes orientation and exit interviews.
  - Restructured and enhanced the presentation and organization of meeting agendas.
  - Restructured and enhanced the organization and presentation of finance and budgeting reports.
  - Assessed and structured the proposal for expanding the Board of Directors to enhance their ability to manage the growing workload of the Academy.
- Branding and Identity:
  - Reviewed, directed, and completed a launching of a Branding/Marketing Campaign.
  - Examined, assessed, and implemented a name change to the Academy of Orthopaedic PhysicalTherapy
- Program Development:
  - Enhanced member growth.
  - Updated all courses in the Residency Curriculum.
  - Provided opportunities for the advancement of the PTA SIG.
  - Developed the framework for the APTA PTA Advance Proficiency Pathways Program in Orthopedics.
  - Added a new SIG: Orthopaedic Residency/Fellowship SIG.
  - Developed a membership volunteer policy and format to enhance membership access to participation in the development and completion of Academy initiatives.
- Increased Advocacy Grants available in 2016 from $15,000 to $25,000.
- Developed a new Career Development Grant.
- Home Office:
  - Staff: Expanded the existing Academy staff to include an Executive Assistant, Publishing Assistant, and ICF-based CPG Coordinator.
  - Real Estate Management: Coordinated and completed a new HVAC system and restructuring of rental agreements and rental space to enhance the stability of real estate value and revenue.

It is important to note that none of these accomplishments could have been achieved without member feedback; our collaborative management from the AOPT Board of Directors; and the time, energy, and efforts from our exceptional operations staff. I encourage all of you to go to the AOPT website and look at the different programs we offer our members and the framework of members and staff who participate in making those programs successful. Again, I THANK ALL OF YOU for all those accomplishments.

What about the next steps? That, of course, will be up to your new President. Since this is your Academy, I hope you will step up to the plate and help your new President continue to move the Academy forward with your vision, ideas, and efforts since the future of the Academy is up to the membership assisting the Board of Directors. I know I will, and I hope to see you there!

Again, many thanks for your encouragement and support during this opportunity to serve you as your President.

Sincerely,
Stephen McDavitt, PT, DPT, MS, FAAOMPT, FAPTA



THE SHOULDER

Independent Study Course 28.2

Learning Objectives

1. Understand shoulder biomechanics and pathomechanics.
2. Understand the components of a thorough physical examination in the diagnosis of rotator cuff tears.
3. Describe the evidence supporting a framework for prescribing therapeutic exercise for shoulder dysfunction.
4. Understand the specific etiology and pathology involved in rotator cuff tears.
5. Describe the rationale for nonoperative and operative treatment of rotator cuff tears.
6. Describe appropriate rehabilitation interventions in the early, middle, and late stages following rotator cuff repair surgery.
7. Describe the risk factors for development of shoulder stiffness and differential diagnosis.
8. Describe the current evidence for nonsurgical management of shoulder stiffness and specific physical therapy interventions.
9. Understand the natural history for adhesive capsulitis and key concepts in the prevention of postoperative stiffness.
10. Describe principles, goals, and quantitative measures of progression in the nonoperative rehabilitation for shoulder instability.
11. Understand advantages and indications for surgical methods to correct shoulder instability.
12. Identify criteria to return to desired activity following a postoperative rehabilitation program.
13. Discuss the structure and criteria for rehabilitation progression governing return to sport for the overhead athlete.
14. Identify appropriate return to play progression modifications to accommodate for workload variations and seasonal factors.
15. Compose a functional testing algorithm for return to activity based on patient expectations.

Editorial Staff

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Gordon Riddle, PT, DPT, ATC, OCS, SCS, CSCS—Associate Editor
Sharon Klinski—Managing Editor

Description

This 6-monograph series addresses the biomechanical, pathological, and evaluative aspects of treating the shoulder. Specific emphasis is placed on the rotator cuff, shoulder instability, and special concerns for the overhead athlete. Therapeutic exercise and return to activity considerations are discussed in detail as well. Decision making and treatment plans for nonoperative and operative scenarios are highlighted. All authors have extensive experience in the evaluation and management of shoulder pathology.

For Registration and Fees, visit orthopt.org
Additional Questions—Call toll free 800/444-3982

Topics and Authors

Clinical Kinesiology of the Shoulder Complex: Foundations for Therapeutic Exercise—Phil Page, PhD, PT, ATC, CSCS, FACSM

Evaluation and Treatment of the Rotator Cuff—Craig Garrison, PT, PhD, ATC, SCS; Joseph Hannon, DPT, PhD, SCS, CSCS; Dean Papaliodis, MD

Evaluation and Treatment of the Stiff Shoulder—Nancy Henderson, PT, DPT, OCS; Ryan Decarreau, PT, DPT, SCS, ATC, CSCS; Haley Worst, PT, DPT, OCS; Jay B. Cook, MD

Management and Treatment of the Anterior Shoulder Instability—Charles A. Thigpen, PT, PhD, ATC; Lane N. Rush, MD; Sarah Babrowicz, BS; Richard J. Hawkins, MD, FRCS(C); Michael J. Kissenberth, MD

Return to Performance: Baseball Athletes and Throwing Programs—Ellen Shanley, PT, PhD, OCS; Thomas J. Noonan, MD; Susan Falsone, PT, MS, SCS, ATC, CSCS, COMT, RYT®

A Functional Testing Algorithm for Returning Patients Back to Activity—George J. Davies, PT, DPT, MEd, SCS, ATC, LAT, CSCS, PES, FAPTA; Eric Hegedus, PT, DPT, PhD, OCS; Matthew Provencher, MD; Robert C. Manske, PT, DPT, SCS, ATC, CSCS; Todd S. Ellenbecker, PT, DPT, MS, SCS, OCS, CSCS

Continuing Education Credit

30 contact hours will be awarded to registrants who successfully complete the final examination. The Orthopaedic Section pursues CEU approval from the following states: Nevada, Ohio, Oklahoma, California, and Texas. Registrants from other states must apply to their individual State Licensure Boards for approval of continuing education credit.

Course content is not intended for use by participants outside the scope of their license or regulation.

ACADEMY OF ORTHOPAEDIC PHYSICAL THERAPY

APTA American Physical Therapy Association

Editor's Note

Making Something from Nothing

Christopher Hughes, PT, PhD, OCS, CSCS

The year was 2004. That's right the same year Facebook launched. This was the year I came aboard as Editor of *OPTP.* My title "Making Something from Nothing" reflects the task and excitement I have had since 2004. Every issue of *OPTP* was a blank canvas that had the allure of creating something where nothing existed, an empty landscape. I really loved it when an issue came together. There has been no greater thrill than finishing final copy and seeing the nothing become something! I honestly cannot say what spurred me to apply for the job in 2004 but I am so fortunate to have acted on the urge and ultimately be offered the job. For the past 15 years I had the privilege of working with the great staff at the home office in La Crosse, WI. Getting to know and closely work with wonderful people who keep the Academy going has been a real blessing. I learned so much about organizational administration, the publication process, and also that La Crosse has a reputation for cranberries! Seeing firsthand how hard our talented team members (Terri, Tara, Leah, Brenda, Laura, Sharon) work to make sure the home base stays in order year after year and from one administration to another is impressive. That standard was always something the editorial staff tried to ingrain into each *OPTP* publication.

Of course there has been no one better to partner with in enforcing this standard and filling the blank canvas every quarter than my Managing Editor, Sharon Klinski. I had the best front row seat to watch the amazing talents of how Sharon was able to edit, organize, and construct a first class publication every issue. If you have ever called the office and chatted with Sharon, you know what I mean. A true professional who treats every member with respect and sincerity. An excellent Editor and a real class act we are lucky to have. When you see the entire first draft and how it transforms to a polished publication you gain a real appreciation for how much pride it takes to dedicate the hours to the painstaking detail that always resulted in a readable and informative work. That's all on Sharon. I had a wonderful mentor for the past 15 years and she always kept me organized and more importantly focused on the correct details! She knew what I needed even before I did. My very own Radar O'Reilly. You youngsters can look that reference up. Sharon, I can't thank you enough for being in the trenches with me and teaching me how to mix the colors and paint the canvas every issue. Thank you so much.

I also want to thank Dr. Chris Carcia who graciously served as Associate Editor from 2015-2016. Dr Carcia was painless to work with and really got us through some busy times. I also want to express appreciation to Michael Wooden for all his work in administering the book reviews through the years. My appreciation also extends to current Associate Editor, Rita Shapiro who stepped in to oversee the reviews upon Michael's retirement. Rita has also edited several submissions and has been a valued asset in sharing the workload and upholding the editorial standard. I also cannot leave out our Advertising Coordinator Marilyn Brodsky… Marilyn always came through for us even during tough advertising cycles. She just had a knack for securing great ads for Sharon to work with to fill each issue. So take all this effort and talent and inevitably, what the reader is left with every quarter is a product that reflects dedication and a passion that was truly teamwork personified. Again, an Editor could not have asked to work with more talented people! All that was right was because of them and anything that was errored was solely my oversight.

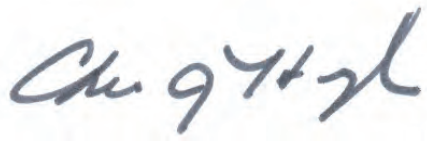
My sincere gratitude and appreciation also extends to the 3 Presidents I have served under (Mike Cibulka, Jay Irrgang, and Steve McDavitt), their governing Board of Directors and all the SIG leaders through the years. A special callout to one of my first Board Liaisons, Dr. Tom McPoil. Their support always enabled me to work effectively and efficiently. I could not help but succeed with all of these talented people behind me.

The other special group that trademarks *OPTP* is all the authors through the years! Honestly, you all have been wonderful to work with. Many of the authors were first-time writers who had something to share but were not sure if they were worthy of putting their ideas and findings into a publication. We knew that and always tried to be "publish friendly." In the end, the Editors always strived to present each article and effort in the best light for every author. I hope we did that. Once again, I extend a heartfelt thank you to ALL the authors. Without your submissions and patience throughout the editing process, I would not have lasted this long. To future contributors; if you are even pondering about submitting an article, please send it in and keep them coming! The best feeling as an Editor is to have a healthy supply of great articles to publish.

Lastly, I would like to welcome the new Incoming Editor, John Heick. I am confident John will do a great job moving things forward and leaving his own editorial mark in advancing *OPTP*. He is well-qualified and is vested in promoting a quality product.

OPTP is what it is. I am proud to have served as Editor for the past 15 years. *OPTP* is a publication that represents the pulse of its readers and has a unique place in providing newsworthy and informative content. I am going to take a nap now.

Thank you for the privilege,



New Year New Editor

John Heick, PT, PhD, DPT

Hello, I want to introduce myself in this inaugural editorial letter to those that do not know me. I am a full-time physical therapy faculty member at Northern Arizona University in Flagstaff, Arizona. My journey is interesting and I will explain briefly. I originally became interested in health care as a 3rd grader when I witnessed my mom falling off her bicycle and I felt a terrible helplessness. This memory stayed with me, and I enlisted in the US Air Force soon after high school knowing that I wanted to be a physical therapist. I decided not to try to become a physical therapist assistant in the Air Force because at that time, a 6-year time commitment seemed like a really long time. Instead, I became a medic and after 2 years, I applied for the special duty assignment and became a flight medic. As a flight medic, I would work in the back of a C-9 plane that was set up as a flying hospital, with a capacity of 40 patients on gurneys and 40 ambulatory patients. Most months, I flew 12 to 15 days and basically lived out of a flight bag. It was a lot of fun, as I would have breakfast in Maryland, lunch in Texas, and dinner in California. I attended classes on a part-time basis and worked my way to becoming a physical therapist. I soon learned that I needed to attend classes full-time or it was going to take many years to reach my goal! I left active duty Air Force after 5 ½ years and moved to Flagstaff, Arizona, to complete my bachelor's degree and entered the Air Force Reserves. Unlike other undergraduate students attending Northern Arizona University, I performed my flight medic duties by driving to March Air Force Base in Riverside, California, then flying to and from Hickam Air Force Base in Oahu, Hawaii for the weekend and then driving back to Flagstaff on Sunday in the wee hours of the night. They were long weekends but I enjoyed having my military connection continue while learning about exercise physiology and anatomy during the week. I got into Shenandoah University's Physical Therapy program and graduated with my Master's degree. My class was the last Master's class so I jumped into the transitional DPT program as soon as I completed my Master's and in the meantime, since my wife is from Arizona, we moved back to Arizona. I started my physical therapy career at St. Joseph's Hospital in Tucson, Arizona. You may remember *PT* magazine's 2000 article regarding physical therapists in the emergency room. This was the same hospital that initiated PT in the emergency department 7 days a week (and continue to do so). I soaked up as much as I could from my colleagues and worked in multiple settings throughout the hospital including their outpatient sports/orthopaedic clinic. It was a fantastic feeling to come to work with colleagues querying each other about the latest and greatest articles that they just read from *JOSPT* and *OPTP*. I had an opportunity to teach nights at a local PTA program and I enthusiastically jumped on it. I learned through this experience that I really enjoyed education especially when students had an epiphany on a topic that I was teaching and was suddenly able to apply this to a patient. My interest in education was sparked while I attended an Arizona Physical Therapy Association state meeting and Jim Roush suggested I apply to teach at A.T. Still University in Mesa, Arizona. Next thing I knew, I was teaching 3 days a week in Mesa and working in the clinic 3 days a week in Tucson. After working and teaching for 12 years, I earned my PhD in Orthopaedic and Sports Science from Rocky Mountain University of Health Professions in Provo, Utah with my dissertation in concussion assessment. I returned to Flagstaff 2 years ago to teach at Northern Arizona University after teaching for several years in Mesa. Currently, I see patients in our pro bono clinic and I work per diem in an orthopaedic outpatient clinic.

I have the pleasure and the pressure of following Dr. Chris Hughes as Editor of *OPTP*. Chris has been the Editor of *OPTP* since 2004 and has done an amazing job. When I first saw that the position was open, I called Chris. We had a great conversation in which he told me as much as possible about the position and what it entailed; he encouraged me to apply for the Editor position. When I interviewed for the Editor position, I reviewed *OPTP* articles starting from the first volume and then every 5 years thereafter to get a feel for the Editor, the journal, and the progression of *OPTP*. Since the beginning of *OPTP*, Dr. Hughes' tour as an Editor represents 33% of the time that *OPTP* has been published! His efforts can be viewed by all by reviewing *OPTP* through the years through our website, just like I did. Amazing, Chris!

My intention with *OPTP* is to continue to produce a clinician-friendly publication that benefits all who read *OPTP*. This past fall, a survey was sent out to all Orthopaedic Academy members to hear recommendations on future directions for *OPTP*. As Editor, I intend to listen to you and make sure I do my very best to produce what you want. Feel free to contact me with your comments or suggestions.

Professionally,
John Heick, PT, PhD, DPT
Board-certified in Orthopaedics, Sports, and Neurology

PHARMACOLOGY

Independent Study Course 28.4

Description

Pharmacology plays a significant role in administering physical therapy to a patient. Clinicians must be aware of not only what medications patients are taking but also the impact these drugs have on the neuromusculoskeletal system. This series covers the most common knowledge needed to effectively understand issues for common cardiovascular conditions, diabetes mellitus, and the management of pain. There are two unique aspects in this series. The first is a re-issue of a popular and previously offered monograph (bonus) that reviews the principles of pharmacotherapeutics. This monograph serves as an introduction for those readers who may not be familiar with pharmacotherapeutics or can serve as a comprehensive review for those who have a previous education on the topic. The second is an audio-based PowerPoint presentation that adds a dynamic element to the coverage of pharmacology and pain management. Dr. Tinsley's oral presentation and excellent slide presentation will engage the listener and allow her to share her enthusiastic conversational style. Case study presentations are included to reinforce the didactic material.

For Registration and Fees, visit orthopt.org
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Effect of Eccentric Exercises at the Knee with Hip Muscle Strengthening to Treat Patellar Tendinopathy in Active Duty Military Personnel: A Randomized Pilot

Kerry MacDonald, PT, DSc, OCS, Dip MDT[1]
Jonathan Day, MA, CPO[2]
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ABSTRACT

Background and Purpose: Tendinopathy is an over-use condition that results in painfully reduced exercise tolerance, mechanical loading capacity, and function negatively impacting soldiers and mission readiness. Investigation of conservative treatment options is critical to facilitate mission readiness. The purpose was to evaluate and compare clinical outcomes (pain and function) following eccentric training (decline squats) with and without the addition of proximal hip strengthening exercises. **Methods:** Forty-one activity duty soldiers (mean age 29.3 years, range 19-38) with patella tendinopathy were randomized to a standard of care (SOC) group (n=17) or treatment group (n=14). **Intervention:** The SOC group performed unilateral 25° eccentric squats (3 sets of 15 repetitions, 2 times per day) for 12 weeks. The treatment group performed the same exercises plus concentric hip strengthening (3 sets of 10 repetitions, 3 times per week) for 12 weeks. **Findings:** We found no significant differences between groups for any of the outcome measures. We observed significant within group differences for all outcome measures. The LEFS SOC increased from 57.7 to 66.8 (p=0.008) and the treatment LEFS increased from 54.8 to 64.8 (p=0.007) at 24 weeks. The VISA-P SOC increased from 51.7 to 70.4 (p=0.001) and the treatment group increased from 51.8 to 72 (p=0.002) at 24 weeks. Both groups reached minimal clinical important difference (MCID) for LEFS and VISA-P at 24 weeks. **Clinical Relevance:** Soldiers may want to consider the addition of hip strengthening as a feasible intervention for the treatment of patellar tendinopathy. **Conclusion:** Favorable effects were demonstrated with patellar tendinopathy using either a combined treatment of eccentric squat and hip muscle strengthening or SOC eccentric squat only group over a 24 week follow-up. The results suggest either treatment strategy is likely to result in improvements when treating an active duty military population.

Key Words: eccentric decline squat, hip strengthening, patellar tendinopathy

Tendinopathy is an over-use condition that results in painfully reduced exercise tolerance, mechanical loading capacity, and function.[1] Clinical management of tendinopathy can be challenging because current treatments fail to return athletes to competitive sport.[2] Such mediocre results can lead to submaximal performance and forced retirement.[3] Patellar tendinopathy is of particular interest to the military, as persistent symptoms with running and jumping can negatively impact soldiers and overall mission readiness. Investigation of conservative treatment options in this population is critical to foster cost-effective mission readiness.

Accurate prevalence data for patellar tendinopathy within the active duty military population is unknown. However, 15.1% of musculoskeletal complaints in a Marine basic training group were classified as patellar tendinitis.[4] Of all exercise and sport-related injuries, 11.8% were classified as tendinitis/bursitis.[5] Tendinitis implies an active inflammatory process; whereas, tendinopathy signifies a generalized pathology in the tendon that includes tendinitis and tendinosis. Determination of the prevalence of either condition appears elusive. Additionally, 41% of all injuries requiring restricted duty were due to anterior knee pain.[6] Anterior knee pain is an all-encompassing term used to describe symptoms around the front of the knee, which due to its general symptomology may include patellar tendinopathy.[7,8] Over-use injuries such as patellar tendinopathy result in a median time of limited or reduced activity of greater than or equal to 15 days[5] to 6 months[6] in non-basic training soldiers. The indirect cost of lost or reduced capabilities and additional manpower required to perform the mission of an injured solider cannot be calculated, but given the median time of up to 6 months of reduced physical capabilities, the burden is considered substantial.

Identifying pain generators in patellar tendinopathy is arduous, with little-to-no evidence of inflammatory cells in the tendon.[9,10] Pain has been postulated to arise from neovascularization,[11-13] chemical irritants such as prostaglandins or neurotransmitters,[14,15] central/peripheral sensitization,[16,17] and mechanical loading.[1,18] Thus, prescribing the correct treatment is daunting. Larsson et al[19] reviewed treatments for patellar tendinopathy which included exercises, injections (corticosteroid and sclerotic agents), extracorporeal shock wave therapy, and surgery and concluded that "physical training, particularly eccentric exercises"[19(p1632)] should be the first line of treatment.

Eccentric exercises effectively reduced pain and improved function in the patellar tendon[12,19–25] for only 50% to 70% patients studied.[2] Perhaps treatment did not include hip muscle strengthening which can also influence knee kinematics. Individuals with patella tendinopathy demonstrated diminished (27%) hip extensor strength[26] and reduced peak knee and hip flexion with jumping[27] causing a sharply increased quadriceps demand[28] leading to mechanically-induced tissue failure. When hip extensor strengthening was combined with jump landing modification during an 8-week intervention, a volleyball player with a 9-month history of patellar tendinopathy experienced a substantial decrease in pain.[29] Frontal plane movements of the femur can alter the line of pull of the quadriceps. Increased hip adduction during walking and running gait[30] produces a

valgus-directed force at the knee. Hip abductor weakness is associated with increased valgus force produced at the knee during jumping[31] and step-downs.[32] With altered knee joint kinematics reported in the sagittal and frontal planes during walking, running, jumping, and step-downs, it is plausible that adding hip muscle strengthening to treat patellar tendinopathy may enhance existing treatment outcomes.

The purpose of this pilot study was to evaluate active duty personnel with patellar tendinopathy and compare clinical outcomes (ie, pain rating and function) following eccentric knee extensor training with or without proximal hip strengthening. We expected participants in the treatment (hip strengthening) group would significantly show improved outcome measures over the standard-of-care (SOC) group that only performed eccentric knee extensor training.

METHODS

Study Design

This pilot study assessed and compared outcomes of unilateral, eccentric 25° decline squats combined with hip muscle strengthening for the treatment of patellar tendinopathy on participants' functional status and pain rating, using the lower extremity functional scale (LEFS), Victorian Institute of Sport Assessment – Patella (VISA-P), Visual Analog Scale (VAS) for pain and jump distance with single-leg and triple-hop tests. This study was approved by the Brooke Army Medical Center Institutional Review Board, San Antonio, Texas.

Setting and Participants

Participants were recruited from primary care, physical therapy, and orthopedic clinics at Ft. Sill, Oklahoma. Inclusion criteria were: age older than 18 years; reported > 3 months' history of anterior knee pain with jumping, squatting, running and/or steps/stairs; palpable pain over the patella tendon; VISA-P score < 75; and in active duty service with at least 6 months' time remaining at current duty station. Exclusion criteria were: VISA-P score > 75; reported pain with prolonged sitting or retropatellar pain; history of knee surgery; reported or radiographic evidence of knee osteoarthritis; rheumatic disease; neuromuscular or cardiovascular disease; diabetes; and pregnancy.

Procedures and Interventions

Participants with anterior knee pain were screened for inclusion and exclusion criteria. After obtaining informed consent, descriptive data were collected on all participants as well as hours participating in fitness activities (organized or unorganized). Participants completed the LEFS and VISA-P questionnaires and VAS for pain with activity. Participants performed the single leg hop and triple hop distance testing described by Noyes et al.[33] Three hops were completed on the symptomatic lower extremity and non-symptomatic lower extremity, with the longest distance recorded as the actual distance hopped. For participants with bilateral symptoms, the right lower extremity was recorded as the symptomatic side for consistency. Participants were randomized using sealed opaque envelopes to either a SOC or a treatment group (Figure 1). If a participant had bilateral patellar tendinopathy, both tendons were treated; however, each tendon was treated with the same intervention. The SOC group performed unilateral eccentric decline squat.[20,23] The treatment group received identical care plus concentric hip muscle strengthening exercises similar to the protocol described by Fukuda et al.[34] Both groups received written instructions on how to construct a 25° decline squat board. Exercise progression was based on the pain monitoring system[35] whereby pain up to 5/10 on numeric pain rating (NPR) was considered acceptable to minimize risk of tissue overload while facilitating a treatment effect.

All treatments were conducted by the same physical therapist. During the course of treatment, participants were allowed to continue with their typical fitness routine using the pain monitoring model[35] described where pain should not exceed 5/10 with any activity. Participants were instructed in the use of an exercise log to measure adherence. Participants were seen weekly during the first month to ensure correct exercise technique and progression. After the first month, treatment frequency was based on participant progression and understanding of instructions. The LEFS, VISA-P, VAS for pain with

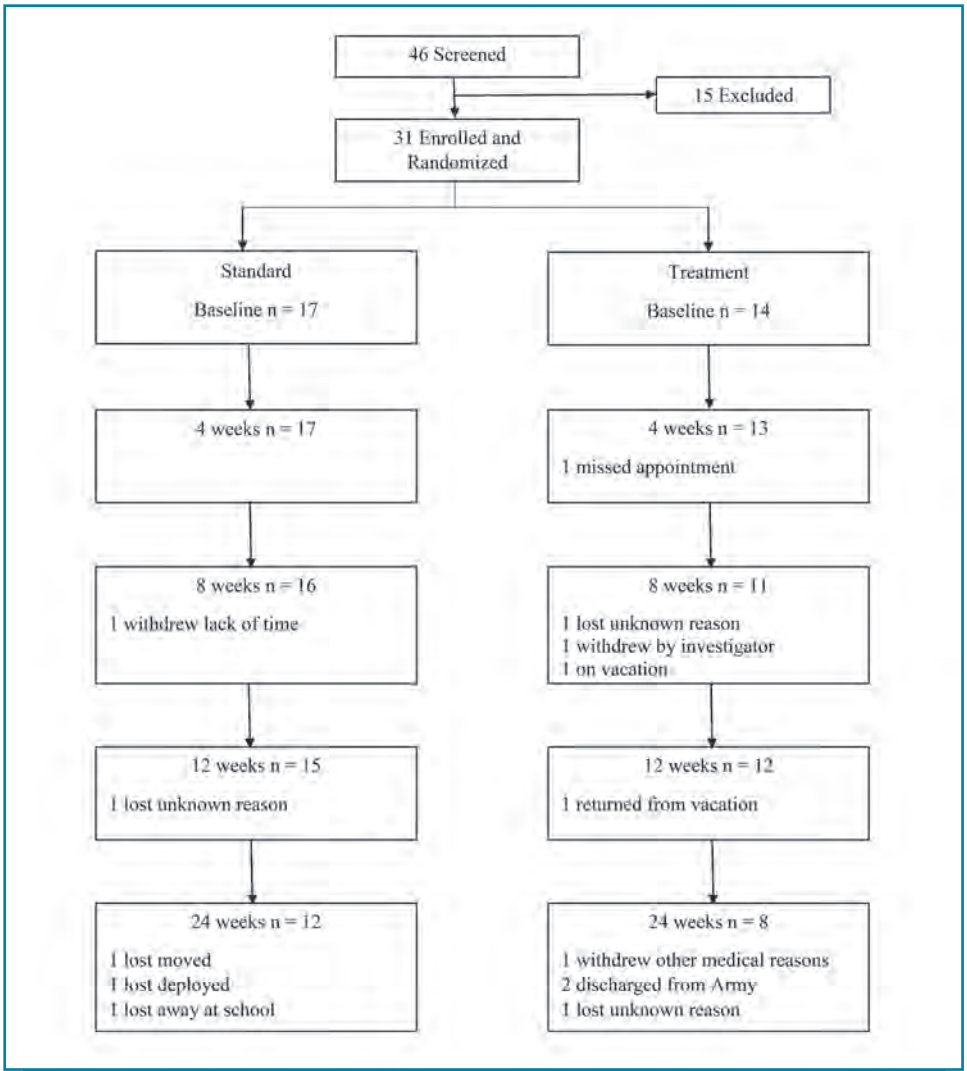

Figure 1. Study flow diagram.

activity, and hop testing were administered by the same therapist performing treatment. All outcome measures were conducted at baseline, 4, 8, 12, and 24 weeks. Participants were instructed to continue with their exercise program between 12 and 24 weeks, but were not seen in physical therapy. They were not prohibited from seeking additional or alternative care.

Outcome Measures

The LEFS is used to evaluate lower extremity musculoskeletal conditions (score 0-80, higher score indicative of high function).[36] The VISA-P is a patella tendinopathy-specific questionnaire, used to evaluate an athlete's symptom severity and function (0-100, higher scores indicate less symptoms/higher function).[37] The VAS for pain with activity is a 10 centimeter line with two anchors. The left anchor is marked as no pain and the right anchor is marked worst pain possible.[38] All are considered reliable and valid outcome measures.

Data and Statistical Analysis

Descriptive analysis was conducted on participant anthropometric and symptomatic data. Independent t-tests assessed difference between groups. A two factor ANOVA (treatment, time) with repeated measures on one factor followed by post hoc least mean squares tests was used to determine differences from baseline to follow-up within and between groups for LEFS, VISA- P, VAS for pain with activity, and jump testing.

Sample size estimation/power analysis

Using the LEFS outcome, based on the effect size in this pilot we found that to determine a difference in these protocols, another study using an alpha = 0.05 and a beta = 0.80, would require a total of 1,134 and 592 participants at 12 and 24 weeks, respectively. Similarly, using the VISA-P outcome 1,468 and 4,228 subjects would be required at 12 and 24 weeks. When we designed this pilot study, we anticipated a larger effect size; therefore, the study was underpowered at 0.058 and 0.053 for the LEFS and the VISA-P at 24 weeks, respectively.

Results

Forty-six participants were screened for inclusion and 31 were enrolled and randomized (17 to the standard-of-care group and 14 to the treatment group; Figure 2). Demographics, anthropometric, and symptomatic baseline data were similar between groups (Table 1). At 12-week follow-up, 2 participants were lost in the SOC and treatment groups. At 24-week follow-up, there were 3 additionally lost in the standard group (30% total loss) and 3 additional in the treatment group (43% total loss). The last known data points were not carried forward with participants lost to follow-up, as the LEFS, VISA-P, and VAS for pain with activity all include elements of pain. If participants were improved and the last known data were carried forward, results could be skewed to underestimate or overestimate progress. Of 31 participants, 14 returned exercise logs. Standard-of-care group returned 5 logs with an average adherence rate of 42.5% of prescribed exercises over 12 weeks. In the treatment group, 9 logs were returned with participants reporting 50% adherence with eccentric squat and 62% adherence with hip muscle strengthening exercises over 12 weeks.

Both groups recorded significantly improved outcome measures of LEFS (standard p = 0.008, treatment p = 0.007) and VISA-P (standard p = 0.001, treatment p = 0.002) over 24 weeks, but no significant differences between groups were observed at 4, 8, 12, or 24 weeks (Tables 2, 3, and 4; Figures 3 and 4). The mean baseline LEFS scores were 57.7 for the SOC group and 54.8 for the treatment group (p=0.53). The mean baseline VISA-P scores were 51.7 for the SOC group and 51.8 for the treatment group (p=0.99). At 12 weeks, the mean LEFS and VISA-P for the SOC group were 66.2 and 67.3 resulting in an 8.5 (p=0.002) and 15.6 (p=0.002) point increase. By 24 weeks, the increase in LEFS from baseline was 9.1 and VISA-P was 18.7 points. At 12 weeks, the mean LEFS and VISA-P for the treatment group were 64 and 63.8 resulting in a 9.2 (p=0.018) and 12.1 (p=0.102) point increase. By 24 weeks, the increase in LEFS from baseline was 9.6 and VISA-P was 20.2 points. Importantly, a direct strength measure such as manual muscle test grading or dynamometry was not measured. These measures could have been correlated with the functional outcome data. This lack of strength data may have limited the study

Standard of Care Protocol

- Unilateral eccentric decline squat 3x15, 2 x per day for 12 weeks
- Produce pain up to 5/10 on NPR, pain must return to baseline within 10 minutes of terminating exercise
- If pain lingered beyond 10 minutes, reduce squat depth or reduce external load
- Increase external load in 5 kilogram increments by wearing a backpack following pain monitoring model
- Continue with current exercise/fitness routine following pain monitoring model

Hip Strengthening Protocol

- Same squat exercises and instructions as Standard of Care group
- Hip strengthening (extension, abduction, and external rotation) 3x10, 3 x per week on both legs for 12 weeks
- Resistance determined by ability to correctly perform 10 repetitions with correct form and advanced using same guideline

Figure 2. Standard of care and treatment protocols.

Table 1. Participant Characteristics at Baseline (Mean ± SD, Range)

	Standard (n=17)	Treatment (n=14)	p
Age (years)	31.3 ± 5.6 (22.1-38)	26.9 ± 7.4 (19.7-42.3)	0.070
Weight (kilograms)	92.2 ± 13.6 (74.2-132)	88 ± 14.8 (63.4-110)	0.414
Height (centimeters)	178.7 ± 7.8 (164-193)	176.9 ± 10.2 (156-192)	0.573
Symptom duration (months)	6.4 ± 3.3 (3-12)	15.3 ± 22.1 (3-84)	0.111
Average hours in sports per week	7.1 ± 3.5 (3-18)	9.1 ± 3.9 (0-15)	0.146
Average miles ran per week	6.8 ± 5.5 (0-15)	7.9 ± 5.9 (0-16)	0.600
Number of female participants	1	1	
Number with bilateral symptoms	3	4	
Note: Significant at p < 0.05			

findings and interpretation of the data.

The VAS for pain with activity scores were significantly reduced over 24 weeks for the treatment group (p= 0.013) and trended a reduction for the standard group (p = 0.052), but no significant difference between groups were observed at 4, 8, 12, or 24 weeks (Table 4 and 5, Figure 5). Single-leg triple hop distance was not different within or between groups at 4, 8, 12, or 24 weeks. Triple hop distance was significantly different within the standard group between 4 and 12 weeks (p=0.044). Outcomes were similar among and between groups at 4, 8, 12, or 24 weeks (Tables 6-9).

DISCUSSION

In contrast to the original expectation, the present trial showed no favorable effects of combined treatment of eccentric squat and concentric hip muscle strengthening over traditional SOC exercises (eccentric squat) for the treatment of patellar tendinopathy over a 24 week follow-up in an active duty military sample. Outcome measures of LEFS and VISA-P significantly improved in both groups over time. Each group attained minimal clinically important difference (MCID) for each outcome measure at 24 weeks. The LEFS improved by 9.2 points in the SOC group and 9.6 points in the treatment group (MCID 9).[36] The VISA-P scores improved by 18.7 points in the SOC group and 20.2 points in the treatment group (MCID 13).[39] The VAS for pain with activity reduced by 1.3 points in the standard group and 2.2 points in the treatment group (MCID 1.3).[38]

One explanation for lack of improvement with the addition of hip strengthening may be attributed to disproportionate time under tension/load of the patellar tendon potentially impairing recovery. Performance of hip extension and abduction requires a concomitant isometric contraction of the quadriceps muscle, mechanically loading the patellar tendon. Cook et al[18] emphasize appropriate load management to facilitate recovery when managing tendinopathy. Sport specificity of the VISA-P offers another possible reason for lack of significant improvement in the treatment group. Soldiering tasks differ from sporting activities. Using a soldier task-specific outcome measure would likely alter results.

Another potential reason for lack of improvement with hip strengthening may be because hip strengthening does not address kinematic deficits. Patellofemoral literature suggests hip strengthening helps reduce pain and improve function, but does not result in kinematic changes.[40-43] Hip weakness is less pronounced in males than females with patellofemoral syndrome[44]; therefore, strengthening of hip musculature results in the greatest improvements in women.[42] The present study included primarily males. Hip strengthening is likely more appropriate when treating females with this condition.

This is the first study to investigate patellar tendinopathy in a military population and combined hip muscle strengthening with SOC exercises. While the results did not favor one treatment over the other, the treatment group resulted in less reported pain with activity and better improvement in VISA-P scores at 24 weeks. Soldiering tasks place significant stress on the patellar tendon. Army physical readiness training, is conducted 5 days per week,[45] and involves plyometric training, running, agility, and general strengthening activities. Some military occupational specialties require heavy lifting while wearing tactile gear during walking, running, or climbing over varied terrains.[46] The results of this trial offer a feasible intervention in the treatment of patellar tendinopathy.

Review of studies with 24-week follow-up comparing eccentric squat to other methods of treatment for patellar tendinopathy yielded similar results. Kongsgaard et al[12] reported VISA-P change score of 22 points (p < .01) for unilateral eccentric squat group in a study involving recreational athletes comparing corticosteroid injection, heavy slow resistive exercises, and eccentric squats. Bahr et al[22] reported an average VISA-P change score of 29 in both groups (single leg decline eccentric squats and open tenectomy) with a study population of participants reportedly participating in fitness activities. Thijs et al[25]

Table 2. LEFS Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=12
	57.5 ± 12.1	61.5 ± 10.9	65.5 ± 9.8	66.2 ± 10.3	66.8 ± 9
	(26-74)	(42-79)	(50-79)	(36-78)	(55-80)
		p=0.194	**p = 0.007**	**p=0.002**	**p=0.008**
Treatment	n=14	n=13	n=11	n=12	n=8
	54.8 ± 13	53.6 ±16.7	63.1 ± 13.4	64 ± 14.4	64.4 ± 17.4
	(34-73)	(27-76)	(34-80)	(35-80)	(34-80)
		p=0.775	**p = 0.026**	**p=0.018**	**p=0.007**
Note: p values measured from baseline to respective time, significant at p< 0.05.					

also reported VISA-P change of 19.3 for a group performing single leg decline eccentric squats (N=30). Each of the respective studies were generally similar to the present regarding baseline characteristics.

In this study, exercise adherence was measured by self-reported exercise logs. Of 31 participants, only 14 returned exercise logs. Standard-of-care group had 5 logs returned with an average adherence rate of 42.5%. In the treatment group, 9 logs were returned with participants reporting 50% adherence with eccentric squat and 62% adherence with hip muscle strengthening exercises. With less than half of the participants returning exercise logs, true rates of adherence are unknown. Comparison of previous patellar tendinopathy studies reported exercise adherence rates as 66%[22] and 72%[20]; substantially higher than reported in the present study. Reasons for lack of adherence with log completion or exercise participation is undetermined, but may be attributed to time and complexity. Escolar-Rina et al[47] reported the most common factor to adherence with home exercise program completion was time and complexity of exercises. In the present study, exercises provoked symptoms. Despite extensive education on the desired and necessary response of pain associated with exercise, some participants may still not have complied due to pain. Hip muscle strengthening resulted in greatest exercise adherence. This exercise required no external equipment other than a resistance band, which was provided to each participant. The eccentric squat exercise required participants to construct a 25° decline board. Complexity of exercise equipment may have limited adherence. Additionally, patients with chronic conditions have a tendency to be less adherent to home exercise programs.[48] Both groups had average symptom durations in excess of 6 months.

Limitations

Participants were seen weekly for the first 4 weeks and then as needed based upon participant and therapist discretion. This type of schedule precludes frequent feedback which has been suggested to improve adherence rates.[49,50] Our 50% adherence with eccentric squat and 62% adherence with hip muscle strengthening exercises over 12-week training period may have been a limitation for this study.

Patient satisfaction was not measured. Previous research[12] has favored heavy slow resistive exercise programs with improved patient's satisfaction and exercise adherence over a home-based program as described above. Both programs provide equivocal results. A common theme reported, while not directly measured, was lack of time to complete prescribed exercise programs due to long work hours.

As this was a pilot study, the investigators observed that the overall protocol was

Table 3. VISA-P Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=12
	51.7 ± 14.2	60.5 ± 11.9	67.1 ± 15.9	67.3 ± 16.1	70.4 ± 18.8
	(28-70)	(41-85)	(44-97)	(42-96)	(47-100)
		p=0.059	p = 0.002	p=0.002	p=0.001
Treatment	n=14	n=13	n=11	n=12	n=8
	51.8 ± 13.7	52.7 ±25.2	59.1 ± 19.8	63.8 ± 25.1	72 ± 28
	(26-73)	(13-96)	(26-94)	(19-97)	(31-100)
		p=0.738	p = 0.393	p=0.105	p=0.002

Note: p values measured from baseline to respective time, significant at p< 0.05

Table 4. Outcome Measures at Time Intervals Between Groups (Mean)

Group	Baseline			4 weeks			8 weeks		
	SOC	Tx	p	SOC	Tx	p	SOC	Tx	p
	n=17	n=14		n=17	n=13		n=16	n=11	
LEFS	57.7	54.8	0.531	61.5	53.6	0.130	65.5	63.1	0.339
VISA-P	51.7	51.8	0.990	60.5	52.7	0.311	67.1	59.1	0.110
VAS	3.9	4.1	0.754	3.7	3.5	0.720	2.5	2.9	0.490

Outcome Measures at Time Intervals Between Groups (Mean)

Measure	12 weeks			24 weeks		
	SOC	Tx	p	SOC	Tx	p
	n=15	n=12		n=12	n=8	
LEFS	66.2	64	0.337	66.8	64.4	0.774
VISA-P	67.3	63.9	0.349	70.4	72	0.840
VAS	2.3	2.9	0.294	2.6	1.9	0.593

Abbreviations: SOC, standard of care: Tx, treatment; LEFS, lower extremity functional scale; VISA-P, Victorian Institute of Sport Assessment – Patella; VAS, visual analog scale

Significant at p< 0.05

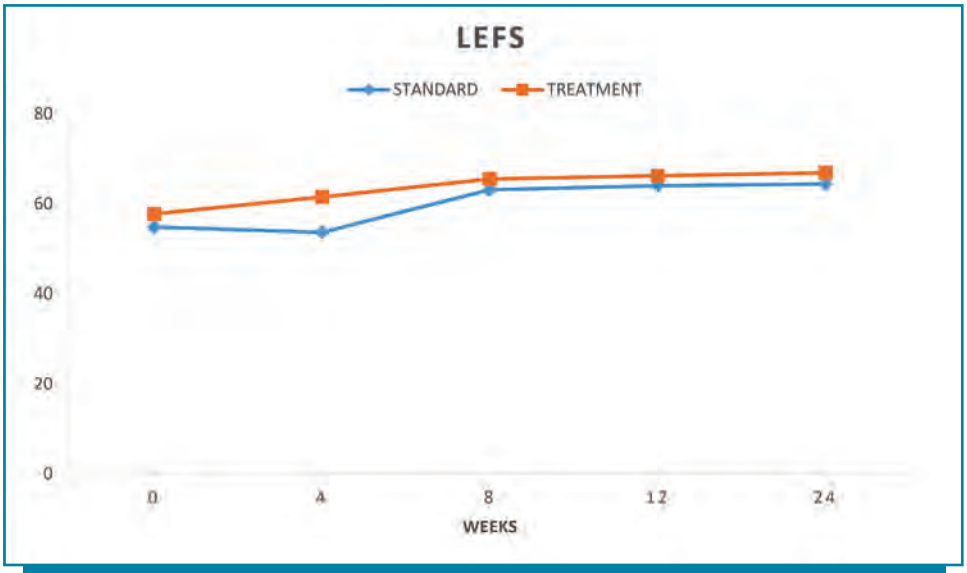

Figure 3. LEFS scores.

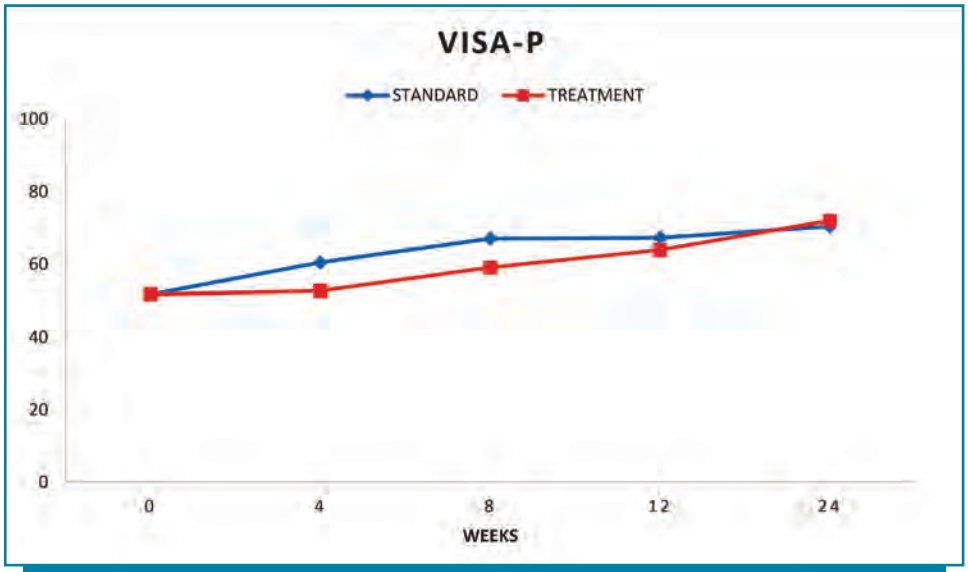

Figure 4. VISA-P scores.

Table 5. VAS for Pain with Activity Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=12
	3.9 ± 1.7	3.7 ± 1.9	2.5 ± 2.2	2.3 ± 1.8	2.6 ± 2
	(1.2-6.9)	(0.2-6.8)	(0-6.3)	(0-5.9)	(0-5.3)
		p=0.768	**p = 0.035**	**p=0.004**	p=0.052
Treatment	n=14	n=13	n=11	n=12	n=8
	4.1 ± 2	3.5 ±2.3	2.9 ± 2.1	2.9 ± 2.2	1.9 ± 1.9
	(1-7.2)	(1-7.8)	(0-7.7)	(0-6.1)	(0-5.3)
		p=0.265	p = 0.202	p=0.093	**p=0.013**

Note: p values measured from baseline to respective time, significant at p< 0.05

feasible but, due to an inherent small sample size, generalizations should be viewed with caution. In the military health care environment, long-term follow-up is threatened, specifically at 24 weeks, due to personnel relocation or discontinuation of military service. Steps were taken in the intake process to minimize this risk. Additionally, the same therapist conducted all treatments and collected all outcome measures that introduces bias yet allowed consistency in protocol.

Future research

Systematic reviews[16,51] and expert commentaries[52,53] highlight the need for investigation of nervous system involvement via central or peripheral sensitization along with cortical reorganization for knee pathology. Research should move away from standardized protocols and should be based on clinical guidelines that focus on pain control, tendon remodeling, intrinsic and extrinsic factors, and altered neural function. Tendon remodeling exercises should remain a central component of treatment programs while also addressing regional interdependence. Both intrinsic and extrinsic factors such as biomechanical faults, age, co-morbidities, adiposity, training volume, intensity, and environment must be appropriately addressed to restore functional ability and reduce/minimize risk of repeat injury.[53]

Cook and Purdam[1] proposed 3 stages of tendinopathy. Effort should be made to establish reliable and valid assessment techniques that allow for appropriate classification of each stage. Once each stage can be accurately classified, treatments can be tested for each homogenous subgroup.

CONCLUSION

Similarly favorable effects were demonstrated in military personnel with patellar tendinopathy using either a combined treatment of eccentric squat and hip muscle strengthening or traditional SOC exercises (eccentric squat) over a 24 week follow-up. Outcome measures (LEFS, VISA-P, and VAS for pain with activity) improved similarly in both groups over time. Low enrollment numbers, poor reported exercise adherence, lack of soldier-specific task outcome measure, and loss to follow-up likely affected results. Overall, both groups improved, suggesting either treatment strategy is likely to result in improvements when treating an active duty military population.

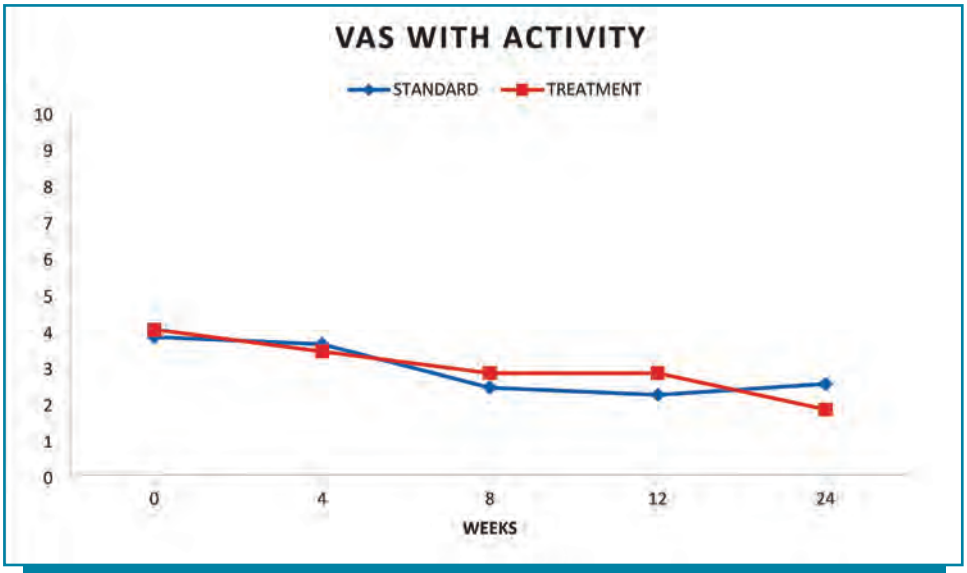

Figure 5. VAS with activity.

Table 6. Single-Leg Triple Hop Involved Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=11
	1.23 ± 0.3	1.24 ± 0.27	1.3 ± 0.27	1.53 ± 0.28	1.3 ± 0.25
	(0.67-1.79)	(0.7-1.57)	(0.62-1.64)	(0.73-1.79)	(0.97-1.17)
		p=0.719	p = 0.448	p=0.376	p=0.307
Treatment	n=14	n=13	n=11	n=12	n=6
	1.25 ± 0.23	1.25 ± 0.25	1.32 ± 0.27	1.35 ± 0.28	1.4 ± 0.22
	(0.8-1.61)	(0.85-1.57)	(0.92-1.68)	(0.75-1.73)	(1.1-1.58)
		p=0.776	p = 0.665	p=0.418	p=0.454

Note: distance measured in meters, p values measured from baseline to respective time, significant at p< 0.05

Table 7. Single-Leg Triple Hop Uninvolved Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=11
	1.28 ± 0.31	1.27 ± 0.25	1.3 ± 0.23	1.26 ± 0.21	1.3 ± 0.23
	(0.77-1.79)	(0.73-1.57)	(0.8-1.58)	(0.8-1.62)	(0.95-1.67)
		p=0.930	p = 0.446	p=0.889	p=0.279
Treatment	n=14	n=13	n=11	n=12	n=6
	1.31 ± 0.27	1.32 ± 0.24	1.36 ± 0.27	1.38 ± 0.29	1.46 ± 0.12
	(0.64-1.62)	(0.78-1.71)	(0.88-1.76)	(0.71-1.78)	(1.25-1.58)
		p=0.392	p = 0.320	p=0.330	p=0.150

Note: distance measured in meters, p values measured from baseline to respective time, Significant at p< 0.05

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Table 8. Triple Hop Involved Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=11
	4.21 ± 0.81	4.29 ± 0.84	4.54 ± 0.85	4.5 ± 0.83	4.33 ± 0.77
	(2.62-5.74)	(1.86-5.29)	(2.38-5.77)	(2.59-6.06)	(3.1-6)
		p=0.875	p = 0.071	p=0.084	p=0.291
Treatment	n=14	n=13	n=11	n=12	n=6
	4.24 ± 0.73	4.39 ± 0.79	4.61 ± 0.89	4.56 ± 0.82	4.69 ± 0.54
	(2.61-5.28)	(3.02-5.97)	(3.22-6.23)	(2.83-6.01)	(3.91-5.26)
		p=0.570	p = 0.104	p=0.264	p=0.281

Note: distance measured in meters, p values measured from baseline to respective time, Significant at p< 0.05

Table 9. Triple Hop Uninvolved Within Groups at Time Intervals (Mean ± SD, Range)

Group	Baseline	4 weeks	8 weeks	12 weeks	24 weeks
Standard	n=17	n=17	n=16	n=15	n=11
	4.28 ± 0.81	4.34 ± 0.73	4.46 ± 0.76	4.41 ± 0.78	4.29 ± 0.85
	(2.83-5.84)	(2.51-5.35)	(2.54-5.59)	(2.68-5.64)	(2.99-5.96)
		p=0.340	p = 0.106	p=0.253	p=0.482
Treatment	n=14	n=13	n=11	n=12	n=6
	4.33 ± 0.79	4.41 ± 0.72	4.49 ± 0.81	4.52 ± 0.87	4.77 ± 0.31
	(2.27-5.44)	(2.64-5.51)	(2.93-5.9)	(2.5-6.08)	(4.36-5.28)
		p=0.483	p = 0.395	p=0.702	p=0.540

Note: distance measured in meters, p values measured from baseline to respective time, Significant at p< 0.05

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Manual Therapy and Exercise in Treatment of a Patient with Cervical Radiculopathy

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Background and Purpose: Cervical radiculopathy (CR) most commonly originates from space occupying lesions. The purpose of this protocol is to observe the short-term effects of specific manual therapy and exercise interventions for the thoracic and cervical spine of patients with CR. **Methods:** This protocol included a single subject pretest-posttest design to determine the short-term effects of thoracic manipulation, cervical rotation mobilization, and exercise in a patient with CR. **Clinical Relevance:** Establishing a specific intervention protocol for the treatment of CR will enable clinicians to use well-defined techniques rather than general multi-modal approaches evident in much of the existing literature. **Conclusion:** We were unable to draw statistically meaningful conclusions about our protocol due to only one subject qualifying for inclusion in this study. However, this subject showed a clinically meaningful change on the Neck Disability Index and Numeric Pain Rating Scale outcome measures suggesting that further investigation using this protocol is warranted.

Key Words: physical therapy, thoracic manipulation

INTRODUCTION

Cervical radiculopathy (CR) most commonly originates from a cervical disc herniation and/or osteophytosis.[1] These space occupying lesions alter sensory and nociceptive signaling near the nerve root resulting in radicular pain.[1,2] Although present-practice patterns in treating patients with CR incorporate the application of a combination of interventions, this study is interested in the short-term effects of 3 specific manual therapy techniques.

Prior to the last two decades, there was limited evidence for the use of thoracic spine manipulation on patients with CR. In 1998, Norlander and his associates found a link between mobility in the thoracic spine and neck and shoulder pain.[3] Neck pain, along with decreased cervical range of motion (ROM), are typical symptoms in patients with CR.[4] Recent studies have published positive results with thoracic manipulation techniques when treating CR. In the design of these studies, researchers used a multimodal approach to treat research subjects. A study by Cleland et al[1] found that 91% of the patients classified their level of improvement as at least "quite a bit better" (+5) on the global rating of change (GROC) scale at discharge. Using the Patient Specific Functional Scale and the Neck Disability Index (NDI), over 90% of patients demonstrated a clinically meaningful improvement in pain and disability, which continued to persist at a 6 month follow-up. A study by Waldrop[2] measured manual therapy treatment outcomes using Northwick Park Neck Questionnaire demonstrating a reduction of neck pain and disability that ranged from 13% to 88%. Due to the fact that thoracic manipulation has previously established positive results in decreasing neck pain, inclusion in a comprehensive rehabilitation program may be justified.[5,6] The *Journal of Orthopaedic and Sports Physical Therapy* 2017 update to clinical practice guidelines included thoracic manipulation in this patient population with a "B" level of recommendation.[7] However, specific protocols have yet to be established for the use of these interventions strategies.

SIGNIFICANCE AND PURPOSE

The protocol proposed in this study is designed to incorporate the available evidence for treating CR with a novel approach to include unilateral rotation cervical mobilization (URCM) in addition to thoracic manipulation techniques directed at the upper thoracic spine and cervicothoracic junction. Langevin et al found that there was no statistically significant difference in manual therapy techniques designed to increase the diameter of the intervertebral foramen (IVF) and manual therapy techniques without that specific goal.[8] However, more research is needed to determine the veracity of those findings and this protocol will include the URCM technique since it has a biomechanical basis in increasing the IVF diameter to reduce nerve root irritation.

Some evidence points to the use of cervical traction to treat CR however a recent meta-analysis and systematic review compared cervical manipulative techniques and traction in immediate effects on pain measured via the Visual Analog Scale found that manipulative techniques resulted in greater decreases in pain,[9,10] thus supporting the proposed protocol for the study.

It was hypothesized that the use of these specific manual therapy techniques will have a positive effect on CR measured by reduced levels of pain, disability, and an improvement in ROM. Therefore, the purpose of this case study was to observe the short-term effects of specific manual therapy techniques directed to the thoracic and cervical spine for a patient with CR.

METHODS

Inclusion/Exclusion with Medical Screening Form

Participants 18 to 60 years of age, and who tested positive for at least 3 out of the 4 test item cluster as reported in the Wainner et al clinical prediction rule (CPR) for diagnosis of CR were recruited.[11] The test items include: (1) a positive Spurling Test A, (2) a positive cervical spine distraction test, (3) an ipsilateral active cervical spine rotation less than 60° towards the symptomatic side, and (4) an Upper Limb Tension Test A for median nerve bias. With 3 out of the 4 items present, this clinical prediction rule has a specificity of 94%, and a positive likelihood ratio of 6.1, making it a useful tool for the diagnosis of CR.[5] Exclusion criteria includes less than 3 positive tests on the CPR, two positive neurologic signs or symptoms suggestive of serious neurological pathology, hypermobility of the thoracic spine, osteoporosis, pregnancy, vertebrobasilar insufficiency, trauma, and previous surgical spine interventions as determined through the questionnaire.[2,5] The study was approved by the University of Puget Sound's Internal Review Board.

OUTCOME MEASURES

The NDI for neck disability assessment and the Numeric Pain Rating Scale (NPRS) for both, the neck and the arm. Active ROM for cervical spine flexion, extension, and lateral flexion were measured using an incli-

nometer and cervical rotation using a goniometer to identify baseline level of ROM.

Intervention Description

The treatment consists of high velocity low amplitude thoracic spine thrust manipulations (TSTM) performed on the mid-thoracic spine and cervicothoracic junction as described by Boyles and colleagues[13] and a lower amplitude non-thrust unilateral rotation cervical mobilizations (URCM) as described by Maitland[14] (Figure 1). If a cavitation is achieved during the first TSTM attempt, the treating therapist proceeds to the next segment. If no cavitation is achieved, the patient is repositioned and the TSTM intervention is repeated for a maximum of two attempts. The grades of the URCM will range from grade 1 to grade 4 depending on the individual patient. The manual therapy treatments are administered in the following order: thoracic manipulations, cervical rotational mobilization, followed by an exercise program of cervical active ROM, chin tucks, self-cervical mobilizations, and barrel hug stretches with rotational holds (Figure 2) that continue at home as well. The NDI and NRPS are completed immediately after treatment. The subjects return 48 hours after initial treatment for follow-up. At that time, they will complete the NDI, NPRS, and GROC, for both cervical and arm pain. Cervical active ROM is also measured following the data collection, the subject's participation in the study is complete.

Patient Outcome

In our study, of the 5 patients screened for CR, only 1 subject met the necessary criteria for cervical radiculopathy reported by Wainner et al.[11] The subject was a 22-year-old male presenting with left sided arm pain provoked by spinous process and ipsilateral articular pillar palpation of the C7 vertebrae. He was also positive on all 4 tests included in the CPR for CR.

Immediately following the treatment his ROM improved exceeding the minimal detectable change (MDC) for cervical right rotation. Forty-eight hours after treatment patient also showed increased ROM in left rotation and further demonstrated improvements in all outcome measures aside from cervical extension ROM (Tables 1 and 2). In addition, the 2-point improvement on the NPRS arm scale reported by the subject immediately postintervention and at the 48-hour follow-up met the established minimal clinically important difference (MCID) threshold.[15] This subject did not reach established MDC or MCID thresholds for the NDI, NPRS for the neck, and GROC.[16-18]

DISCUSSION

Due to the single subject nature of this study, there are many limitations. First, no cause-and-effect can be determined with a single subject. Additionally, it cannot be generalized for the patient population with CR, as there is an obvious lack of a control group with no blinding or randomization. With these limitations in mind, the authors feel it is important to report the findings and hopefully trigger further studies with larger sample sizes, and possibly a randomized controlled trial.

The subject did not meet MDC values for the NPRS in either neck or arm pain. However, the MCID has been shown to be less than the MDC for NPRS arm pain and this subject did meet the cutoff score of 2 points to show clinically important change.[15,16] The authors think that the reduction in the subject's arm pain could be attributed to centralization, which may be an important clinical step in addressing CR. The small change in the subject's reported scores in the NDI, NPRS neck, and GROC could be attributed to the initial low disability level as these outcome measures are less sensitive in capturing change when disability levels are low.[17]

For active ROM, the subject saw an increase in left cervical rotation of 10° postintervention (Table 1) at 48 hours reassessment. While his initial increase in right cervical rotation may be explained by the acute effects of the local rotation mobilizations that were performed in right cervical rotation, the increase in left rotation following 48 hours may be due to the cumulative effect of our interventions indicating a desensitization of the affected nerve root. Ipsilateral rotation is thought to decrease IVF cross sectional area while being an irritant to patients affected by CR. In contrast, rotation away from the affected limb will theoretically increase IVF cross sectional area, which will in turn decrease pressure on the nerve root. This effect coupled with the upstream effects of the thoracic and CT junction manipulations may have realigned the facets to improve the cervical rotation.

The effectiveness of a specific treatment protocol for short-term improvement in patients with CR had not been investigated. Therapeutic interventions in previous studies were applied according to therapist preference.[13,19] Much of the prior research on treatment for cervical radiculopathy used a multi-modal approach of immobilization, manual therapy, traction, exercise, and/or heat and cold, rendering it difficult to determine what specific interventions led to a patient's improvement.[20]

In order to develop a definitive treatment progression for CR it is important to establish the most efficacious treatment option. During the development of the treatment protocol, the authors reviewed a multitude of studies that showed the efficacy of thoracic mobilizations on patients with various types of neck pain and found improvements in pain, ROM, and disability.[20-24] The decision to incorporate thoracic manipulation was based upon regional interdependence.[13,25] Previous research has shown that there is significant movement in the thoracic spine with unilateral and bilateral arm elevation, leading researchers to conclude that impaired cervicothoracic mobility may be an intrinsic cause of shoulder pain.[26] Previous studies have demonstrated that the anterior-posterior thoracic spine manipulation, and upper thoracic spine distraction manipulation were most effective.[2,22,26,27] In regards to mobilizations of the cervical spine a 2011 systematic review found that "gentle mobilizations of the cervical spine" were among the most frequent treatments provided though the actual treatments and parameters were not described.[22] Therefore, our protocol adopted the use of the mid-thoracic spine thrust manipulation, cervicothoracic junction thrust manipulation, and unilateral rotation cervical mobilizations for the manual therapy portion of our protocol.

The primary aim of the home exercise program was to restore normal flexibility, stability, and postural mechanics through the strengthening and conditioning of the cervical stabilizers and increase the limitations of cervical spine movement through flexibility exercises. Postural correction is frequently a part of treatment in order to decrease abnormal mechanical stressors on the cervical spine.[2] To address this, our treatment protocol included chin tuck exercise, barrel hug stretch, cervical self-mobilization, and active ROM exercises. These exercises sans the barrel hug stretch appear frequently throughout the literature in improving outcomes in patients with neck pain and shoulder pain.[2,20,22,26-28]

CONCLUSION

Based on the results of this case report, the authors believe that this treatment protocol or elements warrant consideration as part of decision-making and treatment for patients with CR. The authors believe that the protocol can be safely implemented and does not

Technique	Description of Technique	Illustration
Mid-thoracic spine thrust manipulation	- Start with the researcher standing behind the subject who will be sitting at the edge of the treatment table. - Next, the region of the spine to be thrust is placed against the researcher's chest. - The researcher then reaches around the subject and grasps the subject's elbows, with knees slightly flexed. - The subject is told to relax and take a deep breath. - After exhalation, the researcher will apply pressure to the subject's upper body through the subject's arms. - At the same time, the researcher extends knees to lift the subject's body slightly up and over the fulcrum established by the chest making a J-stroke with the subject's arms.[12]	
Cervicothoracic junction thrust manipulation	- Start with the subject sitting with fingers interlocked behind the lower cervical spine, and the researcher standing behind with his shoulders level with the subject's shoulders. - The researcher then threads the arms through the subject's arms so that the researcher's hands are on top of the subject's hands at the CT junction. - The subject is then told to move their hands as low as they can and to relax their arms. - Care is taken not to hyperextend the patient's shoulder, but rather use the researcher's forearms in a compressive manner anterior to the shoulder. - The researcher then tilts the subject back so that the cervical spine is oriented perpendicular to the floor. - After the subject exhales (on her natural breathing relaxation), the researcher extends his legs and lumbar spine to apply a high velocity low amplitude force against gravity to distract.[12]	
Unilateral rotation cervical mobilization	- Starting with the subject lying supine with her head and neck extended beyond the end of the treatment table and supported by the therapist. - The head will be rotated contralaterally from the painful side. The subject's symptoms determine the grade and range of mobilization used in treatment. The therapist cradles the patient's head and neck with the fingers spread out over the ipsilateral side of the occiput and neck. - The patient's chin is supported with the other hand. The subject's head may be raised and lowered to place the joint being treated between its flexion and extension limits. - The therapist turns the head in the direction it is placed with a simultaneous action of both hands (ie, if the head is rotated to the left for the starting position it will be turned further left for the mobilization). - It is important that the contralateral hand generate the same amount of motion of the occiput as the left hand produces with the chin. This maneuver is produced purely by the researcher's arm movements.[13]	

Figure 1. Manual physical therapy techniques.

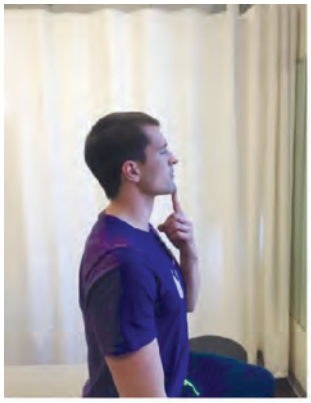
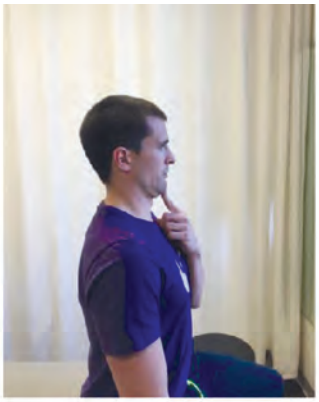
Exercise	Description of Exercise	Picture
Chin tuck	-Start with the patient seated upright. -Next place two fingers on the chin. -The patient then uses the two fingers to gently push the chin straight backward creating a skin roll along the jaw line. Repeat ___ times Perform ___ times daily	 1  2
Barrel hug stretch	-Start with the patient seated upright. -The patient will reach out in front of the body, imitating the motion of hugging a barrel. -Then the patient will rotate from one side to the other and push the chest away from their outstretched hands. Repeat ___ times Perform ___ times daily	 1  2  3

Figure 2. Home exercise program.

require a significant amount of treatment time.[25,29] Due to the limitations previously mentioned, the authors recommend further study using a more rigorous research design.

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Table 1. Cervical Range of Motion Data

Cervical ROM	Cervical Flexion	Cervical Extension	Right Sidebend	Left Sidebend	Left Rotation	Right Rotation
Active ROM Baseline	32	61	42	40	52	49
Active ROM Postintervention	37	60	45	42	54	60
Active ROM 2 Day Follow-up	30	52	46	40	62	52
Change at Follow-up	-2	-9	4	0	10	3

Abbreviation: ROM, range of motion

Table 2. Questionnaire Outcome Measures

Outcome Measures	NDI	NPRS Arm	NPRS Neck	GROC
Baseline	13	5	3	N/A
Postintervention	N/A	3	2	N/A
2 Day Follow-up	8	3	2	1
Change at Follow-up	5	2	1	1

Abbreviations: NDI, Neck Disability Index; NPRS, Numeric Pain Rating Scale; GROC, Global Rating of Change

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Manual Therapy Application in the Management of Baastrup's Disease: A Case Report

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ABSTRACT

Background and Purpose: Baastrup's disease has been described as degenerative bony and soft tissue changes caused by abutment of adjacent spinous processes. Back pain associated with Baastrup's disease has been treated primarily with surgery and injection therapy. This report presents results and clinical reasoning associated with treatment of a patient with Baastrup's disease using manual physical therapy. **Methods:** A 62-year-old male with clinical and radiographic evidence of Baastrup's was treated with manual physical therapy to correct segmental lumbar position and arthrokinematic dysfunction. **Findings:** Comparison of pre and post intervention radiographs demonstrated increased interspinous space that corresponded to complete resolution of back pain at week 5 of treatment. **Clinical Relevance:** This report exhibits effective treatment of back pain in a patient with Baastrup's disease using manual physical therapy. **Conclusion:** Further research is needed to determine if there is a subset of patients with Baastrup's disease that can benefit from manual therapy.

Key Words: Kissing Spine Syndrome, segmental dysfunction, back pain, rehabilitation

INTRODUCTION

Baastrup's disease, also described as Kissing Spine Syndrome, is a spine disorder named after Christian Ingerslev Baastrup, a Danish radiologist (1855-1950).[1] This disorder was described by Baastrup in 1933 as abutment of the posterior aspect of adjacent spinous processes due to spinous process shape, degree of lumbar lordosis and degenerative changes resulting in decreased interspinous distance.[2] Additionally, Baastrup purported that vertebrae act as a lever, the axis of which, in the frontal plane, lies posterior to the middle of the vertebra making the spinous processes the short arm of the lever. He reasoned that this short lever was able to drive the spinous processes against one another with significant force during extension maneuvers especially in patients with hyperlordotic posture. Baastrup concluded that when exerted through the small contact areas of abutting spinous processes these forces produced lesions in the soft interspinous tissues, resulting in osteoarthritic changes that caused further bone abutment, inflammation of interspinous tissues and central low back pain.

Kwong et al[3] noted that since Baastrup's early work there has been controversy as to whether the degenerative changes Baastrup described are clinically significant[4-7] or part of expected changes occurring with age and not a source of back pain.[3,8] However, the preponderance of evidence from anatomic studies,[9,10] advanced imaging,[11,12] and cases of successful intervention including young athletes[7,13,14] support the notion that Baastrup's disease is a disorder of clinical significance with a number of potential pain generators in the interspinous region.

The epidemiology of Baastrup's syndrome is difficult to ascertain. This is due in part to lack of inclusion of this syndrome in the work-up of back pain, nearly ubiquitous degenerative spine changes consistent with Baastrup's in patients over 65 years of age, and adjuvant, concurrent spine pathology that has a similar clinical presentation.[4,8] Kwong et al[3] found a systematic increase in the number of cases of Baastrup's disease with age, when using the description, as evidence of close approximation and contact between apposing spinous processes and sclerosis of the superior and inferior portions of adjacent processes on computed tomography. Maes et al[12] performed a retrospective analysis of 539 consecutive patients undergoing routine lumbar spine MRI for back pain or leg pain. Using the diagnostic criteria described as, the presence of interspinous bursitis, they found Baastrup's disease present in 8.2% or 44 of the 539 patients studied. Similar to the results of the study by Kwong et al,[3] the study by Maes et al[12] also demonstrated an association of increased incidence of Baastrup's with increasing age. Correlation to advancing age notwithstanding, Baastrup's disease has also been reported in young athletes that engage in repetitive lumbar extension maneuvers.[7] Additional epidemiologic research using a consistent operational definition of Baastrup's is needed to more precisely determine the incidence and prevalence of this disease.

Historically, intervention for Baastrup's disease has included partial and total resection of the involved spinous processes and Albee's autoplastic bone graft operation.[14,15] Surgical outcomes have been mixed with findings cited as complete relief, partial relief, and no relief of back pain.[8,14,15] It has been purported that adjuvant degenerative spine changes other than those caused by Baastrup's disease were likely responsible for persistent, postsurgical symptomology.[8,14]

Less invasive interventions than surgery that target likely pain generators in Baastrup's disease have been used more recently. Okada et al[13] prospectively examined the short- and long-term effects of interspinous ligament injections using local anesthetics and steroids for the treatment of back pain in 17 patients with Baastrup's disease. Postinjection, 4 patients reported 60% to 79% relief, 9 reported 80% to 99% relief, and 4 patients reported 100% relief. With long-term follow-up (1.4 years), 15 patients indicated that the treatment met their expectations and 2 indicated limited improvement but a willingness to undergo the same treatment for the same outcome. Lamer et al[4] described the treatment of 3 patients with low back pain contextual to Baastrup's disease with fluoroscopy guided interspinous injections of 2 – 3 mL of 0.25% bupivacaine and 3 mg of betamethasone. Two patients experienced long-term relief. One patient who had severe osseous degeneration and cystic changes had only temporary relief but had complete relief with a subsequent resection of the involved spinous processes. Baastrup's disease is more prevalent in an older population, however, DePalma et al[7] reported successful treatment of L2-3 interspinous bursitis related to Baastrup's disease in a 18-year-old, female, collegiate basketball player. The patient underwent two interspinous bursa injections with 1 cc of betamethasone and 0.25 cc of 4% xylocaine at the L2-3 lumbar spine level over a 14-day interval. The patient's VAS score changed from 6 to 2, she was able to

complete a conditioning program, return to full activity, and she remained asymptomatic at a two month and 12 months follow-up.

There is a dearth of literature regarding physical therapy intervention for Baastrup's disease. Singla et al[5] reported successful management of back pain in a 67-year-old male with Baastrup's disease treated with muscle relaxants and analgesics for one week followed by spinal flexion exercises. At a 6-month follow-up the patient remained asymptomatic. DePalma et al[7] noted the failure of 4 weeks of nonsteroidal anti-inflammatory drugs and stabilization exercises in a previously described case involving an 18-year-old female, collegiate basketball player with Baastrup's disease. Philipp et al[16] purport that physical therapy plays a key role in the long-term management of Baastrup's syndrome in order to reduce interspinous strain and lordosis. However, they offer no research to support this position.

To our knowledge there has been no report of successful physical therapy treatment of low back pain in a patient with Baastrup's disease. The purpose of this report is to present the results and clinical reasoning associated with the treatment of a 62-year-old male with Baastrup's disease using manual physical therapy as a primary intervention.

CASE DESCRIPTION

Patient History

A 62-year-old male presented self-referred to an outpatient physical therapy clinic with reports of central low back pain unrelated to injury. The patient reported a gradual onset of aching and focal pain, in the region of L3-4 spinous process of 3 months duration that had worsened over that time. The pain was worse with lumbar extension and with direct palpation of the L3 spinous process but was relieved with flexion. The pain was rated at 4/10 at rest on a numeric pain rating scale. The patient had received no treatment for the condition but had just completed a 6-week prednisone taper for a dermatologic condition. However, he did not experience a reduction in back pain.

A pertinent review of systems was negative for lower extremity radiculopathy, weakness, or sensory change. The patient's medical history was significant for a remote, left L5 pars fracture from a squat lift accident 32 years earlier but has had no related symptoms for several years. The patient had also been successfully treated with physical therapy for right side sacroiliac joint pain/dysfunction and gluteus medius weakness 6 years prior to this encounter. The patient was otherwise in good physical health. He cycled and engaged in light weight training regularly without exacerbation of his past or current complaints if the extremes of lumbar extension were avoided.

Physical Examination

Physical examination revealed no visible atrophy of lumbar paraspinals. There was focal tenderness with palpation of the midline of the lumbar spine, particularly at L3-4 spinous interspace and processes. Lumbar flexion, extension, side bending right, and left range of motion was unrestricted but lumbar extension past neutral reproduced focal pain in the mid lumbar region. There was no lower extremity muscle weakness detected with manual testing. Bilateral multifidus deficit (left > right) was noted with prone contralateral leg lifting test. Arthrokinematic assessment of the lumbar region revealed segmental mobility loss of L3 flexion/right side bending/right rotation.

Imaging Recommendations and Results

Post initial evaluation, it was agreed that imaging of the lumbar spine was indicated to assess osteology integrity within the region of pain. Anterior-to-posterior and lateral and focused lumbosacral lateral radiographs were obtained. The results are listed in Table 1.

IMPRESSION

Based on the subjective history, objective findings, and imaging studies a diagnosis of Baastrup's disease in the context of lumbar segmental dysfunction was highly probable. A mutual decision was made to proceed with physical therapy as the first line of treatment.

INTERVENTIONS

Treatment was progressed based on interval assessment and consisted of manual therapy to address L3 movement restrictions and positional fault, a home exercise program (HEP) consisting of multifidus re-education exercises, and continuation of the patient's routine lumbar flexion exercises. See Table 2.

OUTCOMES

The patient attended 5 physical therapy sessions (once per week) post initial evaluation over a 7-week period. During assessment at week 5, the patient reported 0/10 pain since the prior session, L3-4 interspace was no longer painful to palpation, multifidus contraction had normalized, and an arthokinematic assessment revealed normal L3 segmental mobility. See Table 2, session 4 (week 5). A repeat lateral x-ray of the lumbosacral spine was performed at the same facility by the same technician using the same positioning used during the pretreatment radiograph. See Figures 2 and 4. The radiograph demonstrated evidence of reduced spinous abutment of L3 on L4 as evidenced by increased interspinous space, reduced sclerosis at the previous L3-4 abutment site, and remodeling scalloped bone on the L4 spinous process. A modified Ferguson method of lumbosacral angle measurement was performed to assess potential differences in lordosis during the pre- and post-lateral x-rays. The lumbosacral angles differences were negligible. See Figures 5 and 6.

The posttreatment image findings were reviewed during session 5 (week 7) and deemed concordant with the clinical assessment in which the patient was painfree, demonstrated normal multifidus contraction, and normal segmental mobility of L3. See Table 2. Session 5 (week 7). The patient was discharged with a HEP of continued passive flexion exercise and multifidus re-education exercise, which was integrated into the patient's current fitness program.

DISCUSSION

In the case of Baastrup's disease under consideration, it was postulated that arthrokinematic dysfunction could be a contrib-

Table 1. Pretreatment Anterior-to-Posterior, Lateral, and Coned View X-ray of the Lumbar Spine Findings

• Spinous process abutment at the interspace of L3-L4 (Figures 1 & 3) otherwise normal alignment of the lumbar spine with no evidence of hyperlordosis or scoliosis or spondylolisthesis.
• Sclerosis was seen at the abutment surfaces of L3-4, and bone scalloping on the superior surface of L4 (Figures 1 & 3). Osteology was otherwise normal with no evidence of osteoporosis, fracture, or tumor.
• Apophyseal cartilage loss and sclerosing arthritis changes were noted at L4-5 and L5-S1. Disc space height was preserved at all visible levels.
• Visualized soft tissues appeared normal.

Table 2. Interval Assessment and Treatment Progression

Sessions	Assessment	Treatment	Plan
Session 1 (Week 1)	Pain: 4/10 (at rest) Palpation: Moderate tenderness L3-4 interspinous space Segment mobility: Marked restriction of L3 flexion/right side bending/right rotation Neuromuscular: Multifidus deficit with contralateral leg lifting test • Left - contraction not palpable • Right - contraction minimally palpable Lateral lumbar x-ray (Pre RX): • abutment of L3-4 spinous process • pseudoarticulation at L3-4 interspinous space • sclerosis of abutment surfaces of L3-4 • scalloped bone on the L4 spinous process	Joint Mobilization: Activation of L3 flexion/right side bending/right rotation Therapeutic exercise: Closed chain trunk rotation 1 x10 reps (multifidus activation) Spine flexion stretch with floor mount bar 30 sec duration, 3-4x/week	Progress closed chain trunk rotation to 1X 15 3-4x/week Continue spine flexion stretch 3-4x/week Follow-up with PT in 1 week
Session 2 (Week 2)	Pain: 4/10 at rest. 0/10 X 1-day post 1st treatment Palpation: Moderate tenderness L3-4 interspinous space spinous space Segment mobility: Moderate restriction of L3 flexion/right side bending/right rotation Neuromuscular: Multifidus deficit with contralateral leg lifting test • Left - contraction minimally palpable • Right – contraction distinctly palpable	Joint Mobilization: Activation of L3 flexion/right side bending/right rotation Therapeutic exercise: Closed chain trunk rotation 1 x15 reps (multifidus activation) Spine flexion stretch with floor mount bar 30 sec duration, 3-4x/week	Progress closed chain trunk rotation to 1X 20 3-4x/week Continue spine flexion stretch 3-4x/week Follow-up with PT in 1 week
Session 3 (Week 3)	Pain: 2/10 at rest. 0/10 X 5 days post 2nd treatment Palpation: Minimal L3 spinous process tenderness Segment mobility: Minimal segmental restriction L3 flexion/ right side bending/right rotation Neuromuscular: Multifidus deficit with contralateral leg lifting test • Left - contraction distinctly palpable • Right - contraction distinctly palpable	Joint Mobilization: Activation of L3 flexion/right side bending/right rotation Therapeutic exercise: Closed chain trunk rotation 1 x20 reps (multifidus activation) Spine flexion stretch with floor mount bar 30 sec duration, 3-4x/week	Progress closed chain trunk rotation to 1X 25, 3-4x/week Continue spine flexion stretch 3-4x/week Follow-up with PT in 2 weeks
Session 4 (Week 5)	Pain: 0/10 since completion of session 3 Palpation: No L3 spinous process tenderness Segment mobility: No detectable segmental restriction L3 flexion/right side bending/right rotation (right equal to contralateral side post session 4) Neuromuscular: No palpable deficit of bilateral multifidus response with contralateral leg lifting test	Joint Mobilization: Activation of L3 flexion/right side bending/right rotation Therapeutic exercise: Closed chain trunk rotation 1 x20 reps (multifidus activation) Spine flexion stretch with floor mount bar 30 sec duration, 3-4x/week	Continue closed chain trunk rotation to 1X 25, 3-4x/week Continue spine flexion stretch 3-4x/week follow-up 2 weeks Requested repeat post treatment lateral radiograph of lumbar spine. Follow-up with PT post x-ray
Session 5 (7 weeks)	Pain: 0/10 since session 3 Palpation: No L3 spinous process tenderness Segment mobility: normal L3 flexion/right side bending/right rotation (= to contralateral side) Neuromuscular: Normal bilateral multifidus response with contralateral leg lifting test Lateral lumbar x-ray (Post RX): • increased interspinous space at L3-4 • reduced sclerosis of both L3 and L4 • remodeling of scalloped bone on the L4 spinous process	Joint Mobilization: assessment of L3 flexion/right side bending/right rotation Therapeutic exercise: Closed chain trunk rotation 1 x25 reps (multifidus activation) Spine flexion stretch with floor mount bar 30 sec duration, 3-4x/week	Discharge to self-care with home exercises and avoidance of hyperextension activities Follow-up with PT PRN

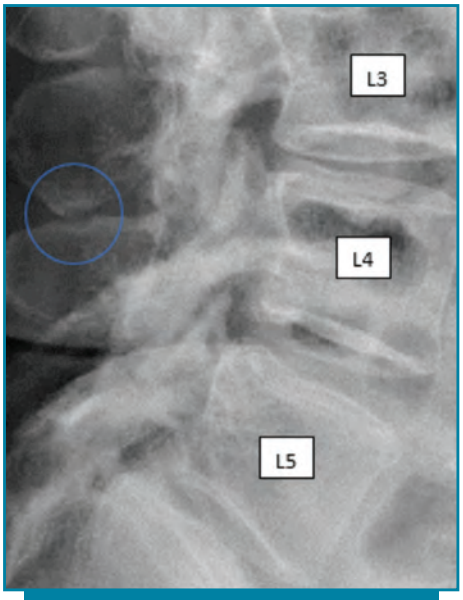

Figure 1. Standing lateral x-ray of lower lumbar spine prior to physical therapy.
L3-4 interspinous space demonstrates evidence of spinous process abutment, pseudo-articulation, sclerosis at the abutment surfaces, and bone scalloping on the superior surface of L4.

Figure 3. Focal view of L3-4 interspace prior to physical therapy. Normal mode x-ray mode clearly demonstrates loss of interspinous space and abutment of L3-4 spinous processes.

Figure 4. Focal view of L3-4 interspace post physical therapy. Color inversion mode x-ray clearly demonstrates increased L3-4 interspinous space and decreased degenerative changes.

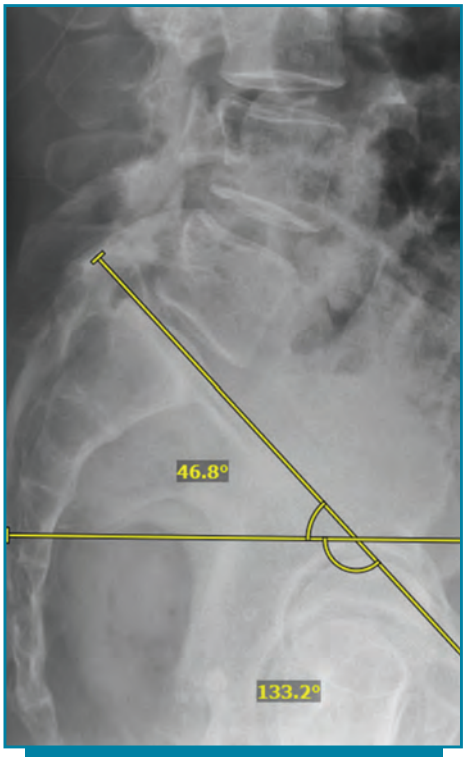

Figure 6. Posttreatment x-ray lower lumbar spine.
Lumbosacral Angle (Ferguson Method) 46.8°.

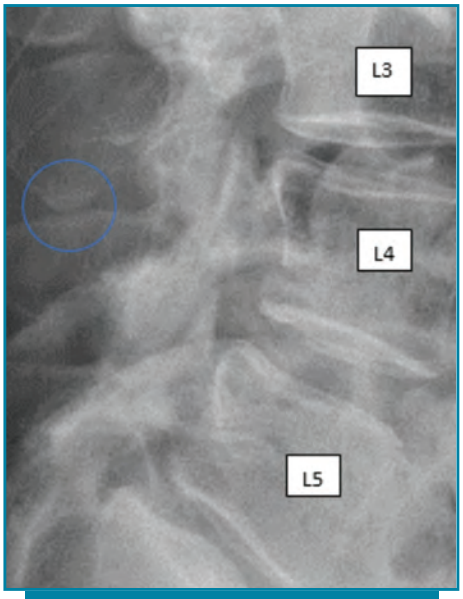

Figure 2. Standing lateral x-ray of lower lumbar spine post physical therapy.
L3-4 interspinous space demonstrates evidence of increased space, reduced sclerosis at the abutment surfaces, and bone remodeling of scalloped bone on the superior surface of L4.

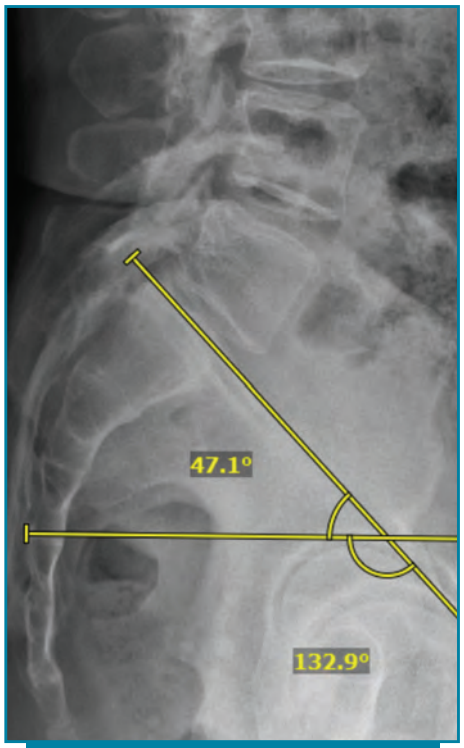

Figure 5. Pretreatment x-ray lower lumbar spine.
Lumbosacral Angle (Ferguson Method) 47.1°.

uting etiology to lumbar spinous process abutment and subsequent back pain. This notion has theoretical support in anatomy and biomechanical literature. The biomechanics of the lumbar spine are largely regulated by apophyseal joint orientation. There is an abrupt transition of the apophyseal joint orientation at the thoracolumbar junction from frontal plane to near sagittal plane orientation in L1-2 with a very gradual transition toward the frontal plane in the mid lumbar region to near the frontal plane orientation of L5-S1.[17-19] This orientation results in facilitation of sagittal plane motion in the upper and mid lumbar segments. Chronic lordosis posture or high force acute extension in the context of sagittal plane bias has the potential to slide the inferior facets of a superior lumbar segment beyond physiologic range until they impact the lamina or until the spinous processes abut.[2,17,20] Based on these known biomechanics and clinical findings of the patient under consideration, it was postulated that apophyseal hypomobility dysfunction could sustain a lumbar segment in extension resulting in chronic spinous abutment as seen in Baastrup's disease. The positive clinical outcome and increased interspinous space at L3-4 seen on radiographic images

following mobilization in this case supports this notion.

Early concepts in manual physical therapy emphasized assessment and treatment of segmental joint function including that of the spine.[21] There has been considerable research demonstrating effectiveness of segmental assessment and treatment of spinal pain and dysfunction,[22-26] however, Trijffel et al[27] found that the rationale, methodology, and application to clinical reasoning and treatment using manual therapy varied among therapists. Additionally, some of the early postulates of spinal motion segment assessment and treatment are being challenged based on lack of intertester reliability, validity, and definitive mechanism(s), particularly in the treatment of nonspecific low back pain.[28-32]

It must be noted however, that in the case under consideration there was clinical and radiographic evidence that the patient's pain had identifiable etiology and mechanism. Thus, the intended mechanism for manual therapy intervention was clear; correction of L3 hypomobility and position fault to arrest spinous abutment and pain. The ability to correct lumbar spine segmental hypomobility and position with manual therapy is supported in the animal, cadaver, and human reseach.[33-38] Additionally, pre- and posttreatment radiographs enabled correlative assessment of the validity of the practitioner's manual pre- and post-segmental mobility testing. It could be reasonably argued that variance in the lumbosacral lordosis in the pre- and post-lateral spine x-rays could have accounted for the increased interspace seen posttreatment. However, measurement of the lumbosacral angle with a modified Ferguson technique with the patient in weight bearing demonstrated only 0.3° reduction in lordosis in the posttreatment film. Performance of this measurement on lateral lumbar films in standing has been previously reported.[39] The reliability of this modified technique has not been established. However, the small variance in radiographic measurement of pre- and posttreatment lumbosacral angles suggests that the increased interspinous space seen on the posttreatment film was due to a change in segmental position. Therefore it was not a result from variance in lordosis in pre- and posttreatment x-rays.

Outcome measures considered in this case included patient report of posttreatment pain levels on 0/10 scale for which validity, reliability, and responsiveness have been established;[40-42] segmental mobility of L3 as determined by manual therapy reassessment for which only intratester reliability was an issue; and reassessment of L3-4 spinous process interspace and surrounding structures via comparison of pre and post manual therapy x-rays. Results included (1) patient report of 0/10 pain at discharge, (2) therapist report of restoration of L3 segmental mobility, (3) and radiographic evidence of increased L3-4 interspace as well as evidence reduced sclerotic changes and remodeling of scalloped bone. These results provided correlative evidence for the utility of manual therapy assessment and treatment of Baastrup's disease in this patient.

There were limitations in this case study that constrain conclusions that can be drawn and extrapolated to other patients with Baastrup's disease. First, the etiology of Baastrup's disease can be from causes other than segmental movement dysfunction and positional fault. These causes can be multifactorial and include hyperlordosis, intrinsic morphology of the spinous process, pseudoarticulation between the processes, and loss in disc.[2,3,42] Another limitation when applying findings of this study to all patients with Baastrup's disease is that the patient in this case had only experienced symptoms for 3 months duration and had only modest arthritic changes at the abutting interspinous space. As previously noted, patients with more advanced cases of Baastrup's disease may have developed significant interspinous bursitis, osteophytosis of spinous processes, interspinous ligament inflammation and hypertrophy, and spinous process fracture[2,3,42,43] which would limit or eliminate potential efficacy of correcting segmental hypomobility and or position. Lastly, pre- and post-MRI imaging of dynamic movement similar to that performed by Xia et al[43] to assess in vivo range of motion of the lumbar spinous processes would have been more representative of the spinal mechanics associated with activities of daily living that could exacerbate the symptoms of patients with Baastrup's disease. This type of imaging procedure could also provide the therapist considering manual therapy intervention with greater insight into segmental movement dysfunction and the best treatment approach to resolve it. While this level of diagnostic movement assessment was not indicated for this case, it could be a consideration for controlled studies involving patients with Baastrup's disease in the future.

CLINICAL APPLICATION

Baastrup's disease or Kissing Spine Syndrome has previously been described as abutment of the posterior aspect of adjacent spinous processes due to aberrant morphology, hyperlordosis, degenerative changes, or other factors that decrease interspinous distance. Elimination of back pain concurrent with radiographic evidence of increased L3-4 interspinous space and diminution of degenerative changes in the patient under consideration highlights the potential utility of manual physical therapy intervention. This case report highlights the possibility of segmental lumbar mobility dysfunction as an additional etiology of spinous abutment and pain associated with Baastrup's disease. Further research involving manual therapy and dynamic imaging is needed to determine the prevalence of patients with Baastrup's disease related to segmental spine dysfunction and the effectiveness of manual physical therapy as a conservative intervention in that cohort of patients.

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Clinical Application: Physical Examination Procedure to Assess Hip Joint Synovitis/Effusion

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ABSTRACT

The purpose of this article is to describe a physical examination procedure that can be used to infer the presence of clinically significant hip joint effusion. The clinical examination procedure is operationally defined. The findings of the examination procedure can be used to recommend additional diagnostic imaging, and can assist in providing guidance and objective criteria to modify rehabilitation protocols. The operational description of the examination procedure provides a starting point for research to investigate diagnostic accuracy (reliability, sensitivity, sensitivity, and likelihood ratios) for this method.

Key Words: hip, evaluation, pathology, clinical decision making

BACKGROUND

Synovitis occurs in association with conditions such as rheumatoid arthritis, gout and lupus, etc. It can also be seen in patients with osteoarthritis. Chronic synovitis can lead to joint destruction. Symptoms of synovitis are joint pain, swelling, and nodules. Tenderness is not a very good indicator of synovitis. Synovitis is an important feature in management of musculoskeletal pain problems and is indirectly manifested as joint effusion or swelling.[1] Just as there are differences in how we measure pain, there are differences in how we detect joint synovitis or joint effusion. The prevalence of significant synovitis is difficult to determine because of the varying diagnostic techniques and it is likely under reported.[2] There is wide variation as to how knee joint effusion is observed and reported. A majority of the unstandardized clinical tests to assess joint effusion in knee osteoarthritis have relatively low intra- and inter-observer reliability.[3] Examination and documentation of joint effusion are an important part of the diagnostic and treatment processes.[2]

Physical examination of joint effusion is used for a variety of purposes including:

- To suggest that more sophisticated diagnostic imaging techniques should be used to quantify the amount of effusion (diagnostic ultrasound, radiograph, or MRI)
- To suggest that invasive measurement using volume arthrocentesis is indicated[4]
- To suggest that intervention to address possible synovitis is indicated[5]
- The early identification of synovitis related to systemic arthritic conditions, and monitoring and managing a systemic arthritic condition
- To provide guidance and objective criteria to adjust rehabilitation protocols[5]

Studies of knee and ankle joint effusion have provided evidence that joint effusion can cause muscular inhibition adversely affecting rehabilitation and recovery.[6-8] Hip joint effusion is a significant contributor to gluteal muscle inhibition.[7] It is likely the arthrogenic muscle inhibition process occurs at the glenohumeral joint; however, this concept has not been investigated.[8]

Observation and measurement of joint effusion can be a valuable sign to determine criteria for progression through stages of post-op protocols.[9] As seen in Table 1, clinicians at the University of Delaware propose the symptom of pain, and the objective sign of observation of joint effusion in the knee joint as criteria to guide whether to have the patient do more exercise/activity; decrease amount of exercise/activity, or to keep the amount of exercise activity at the same level.[5,9]

At the hip joint, signs of joint synovitis and effusion are a bit more difficult to recognize because of the depth of the hip joint and size/volume of the large gluteal muscles.[10]

Circumferential measures of the hip joint raise some suspicion of significant joint effusion, but it would be helpful if additional physical examination could provide support for the same.[11] Girth measures are not sensitive or responsive enough to use as clinical guidelines in post orthopedic knee surgery protocols.[5]

There is a need for a physical examination process that can be used to make inferences regarding the presence and quantity of joint effusion at the hip joints. This can further justify the need for diagnostic imaging to help determine the extent of effusion and tissues involved, which can further assist to identify whether the swelling is intra- or extracapsular. There is a need for physical examination procedure of the hip joint effusion that the clinician can use to adjust the amount of exercise and to determine progression through rehabilitation protocols.

PURPOSE

The purpose of this article is to describe a physical examination procedure that can be used to infer the presence of clinically significant hip joint effusion.

The following concepts were considered in the development of the unique physical examination procedure. The examination procedure must demonstrate inter- and intra-rater reliability.

The assessment requires collecting supportive subjective history and information. Physical examination looking for joint effu-

Table 1. Guide Using Joint Soreness and Joint Effusion to Progress Exercise or Rehab Protocol

Eligible to progress exercise/protocol	No joint soreness after last session	No evidence of joint effusion
Eligible to progress exercise/protocol	Joint soreness after last session gone by next morning	No evidence of increase or change in amount of joint effusion
Stay with same amount of exercise or protocol level	Joint soreness for 24 hours after last session	Physical examination demonstrates increase in amount of joint effusion from previous visit
Regress the amount of exercise or protocol level	Joint soreness for more than one day after last session	Physical examination demonstrates increase in amount of joint effusion from previous visit

sion uses a ballottement maneuver, light quick poking motion looking for and/or feeling for displacement of fluid or sensation, or rebound. In an effort to improve reliability of observation and measurement, the examination procedure needs to be performed in a standardized manner.

PROCEDURE

Begin with visual observation of size, girth; shape of anterior hip joints. If the problem is unilateral, look to see if there is symmetry or asymmetry (Figure 1).

The patient lies supine with the limb relaxed with the hip joint in position of relative extension and medial rotation. Palpate the uninvolved side first in order to establish a relative baseline of normalcy or benchmark to compare the involved side.

Lightly palpate the anterior aspect of the hip joint, uninvolved hip joint first, assessing the degree of puffiness or swelling (Figure 2). If the patient has had surgery, the surgical scar can be used as a landmark. Place one hand along the anterior lateral hip/thigh just distal to the hip joint. Press down and in an upward direction towards the head, and squeeze the thigh and sweep slide along the anterior lateral aspect of the hip/thigh. Perform 2 to 3 sweep slides consecutively alternating hands. You are trying to move or performing a milking effect of the effusion from the inferior anterior hip joint capsule superiorly (Figure 3).[5]

After the last sweep, sustain and hold the squeeze while with the opposite hand palpates the anterior aspect of the hip joint. Comparison can be made between the amount of soft fluid like material during palpation with and without the manual sweep and squeeze procedure (Figure 4).

If the hip pain and suspected joint effusion is unilateral, a rating of the magnitude of feeling the soft fluid material can occur using the following criteria:

- no sign of joint effusion relative to the uninvolved side,
- mild amount of joint effusion relative to the uninvolved side, and
- significant amount of joint effusion relative to the uninvolved side.

DISCUSSION

A description of a physical examination procedure that can be used to infer the presence of clinically significant hip joint synovitis, and hip joint effusion has been presented. This examination procedure may provide valuable information regarding the presence or absence of intraarticular fluid and propose appropriate imaging studies for quantification. In order for this test to be widely implemented, a case series needs to be conducted to demonstrate the reliability and validity of this test. Data collection in various practice locations and by various providers to determine similar findings and further follow-up with sonogram or MRI is warranted. Diagnostic values such as sensitivity, specificity, and likelihood ratios could then be calculated.

Figure 1. Note the asymmetry of shape (bulge) on the right side (yellow arrow).

Figure 2. Palpate the anterior aspect of uninvolved hip joint followed by involved hip joint.

Figure 3. Squeeze, sweep, milking of joint fluid in a cephalic direction.

Figure 4. Perform a ballottement maneuver, light quick poking motion looking for and/or feeling for displacement of fluid or sensation or rebound.

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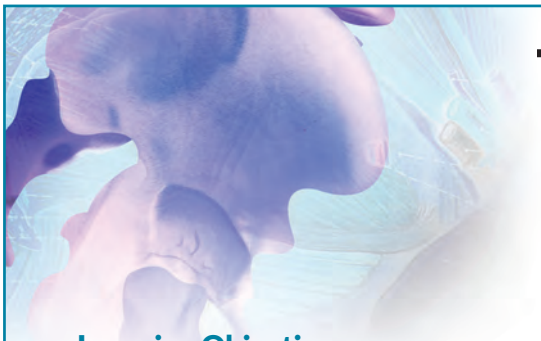

THE LUMBOPELVIC COMPLEX: ADVANCES IN EVALUATION AND TREATMENT

Independent Study Course 28.3

Learning Objectives

1. Demonstrate an understanding of the value of assessing serious pathologies and co-morbidities in managing patients with low back pain.
2. Demonstrate an appropriate interpretation of the patient's history and physical examination findings into patterns that guide the treatment.
3. Recognize acute and subacute low back pain patterns and the rehabilitation that is prescribed for each.
4. Understand the theoretical basis for spinal stability and movement coordination.
5. Formulate a structured evidence-based examination algorithm to identify relevant movement coordination impairments of the lumbopelvic complex.
6. Apply the examination algorithm to develop optimal procedural interventions with regard to proper exercise dosing.
7. Define different types of pain and identify common pain patterns.
8. Describe the relevant clinical anatomy of the lumbopelvic region to allow for accurate clinical examination and identification of possible sources of symptoms.
9. Understand the most common clinical presentations of low back pain with radiating pain conditions to provide a framework for the clinical examination.
10. Understand the basis and progression of neuropathic pain and the development of chronic pain syndromes.
11. Screen for possible sources of low back pain that require medical referral.
12. Use and interpret appropriate psychosocial screening tools to assist in identifying personal factors that influence patient management and prognosis.
13. Integrate research evidence to support the use of manual therapy, including high-velocity low-amplitude spinal mobilizations in the treatment of low back pain with radiating pain.
14. Discuss current evidence for non-pharmacologic and pharmacologic interventions for older adults with low back pain.
15. Identify one or more strategies for incorporating patient-centered care into the plan of care for an older adult with low back pain.
16. Develop an understanding of evidence-based management of adolescents with low back pain and when imaging is indicated.
17. Understand the concepts of exercise progression to prepare a treatment program for an adolescent athlete, beginning with simple, early stage exercises progressing to advanced, sport-specific movements.

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This course provides a comprehensive resource for the clinician who seeks evaluation and treatment expertise for patients who suffer low back pain. Particular emphasis is placed on defining the facets governing spinal stability, assessing movement patterns, and differentiating among types of pain and how each is effected in patients with low back pathology. Specific monographs are dedicated to the geriatric and pediatric populations. A unique feature of the course is the inclusion of 39 patient resource pamphlets that can be used for patient education.

Topics and Authors

Acute ad Subacute Lumbopelvic Deficits: Lumbosacral Segmental/ Somatic Dysfunction—Muhammad Alrwaily, PT, MS, PhD, COMT; Michael Timko, PT, MS, FAAOMPT

Acute, Subacute, and Recurrent Low Back Pain with Movement Coordination Impairments—Won Sung, PT, DPT, PhD; Ejona Jeblonski, PT, DPT

Acute and Subacute Low Back with Radiating Pain—Robert Rowe, PT, DPT, DMT, MHS, FAAOMPT; Laura Langer PT, DPT, OCS FAAOMPT; Fernando Malaman, PT, DPT, OCS, FAAOMPT; Nata Salvatori, PT, DPT, OCS, SCS, FAAOMPT; Timothy Shreve, PT, OCS, FAAOMPT

Low Back in the Geriatric Population—Jacqueline Osborne, DPT, GCS, CEEAA; Raine Osborne, DPT, OCS, FAAOMPT; Lauren Nielsen, DPT, OCS, FAAOMPT; Robert H. Rowe, PT, DPT, DMT, MHS, FAAOMPT

Adolescent Spine—Anthony Carroll, PT, DPT, CSCS, OCS, FAAOMPT; Melissa Dreger, PT, DPT, OCS; Patrick O'Rourke, PT, DPT, OCS; Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA

Patient Educational Resources for the Spine Patient—W. Gregory Seymour, PT, DPT, OCS; J. Megan Sions, DPT, PhD, OCS; Michael Palmer, PT, DPT, OCS; Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA

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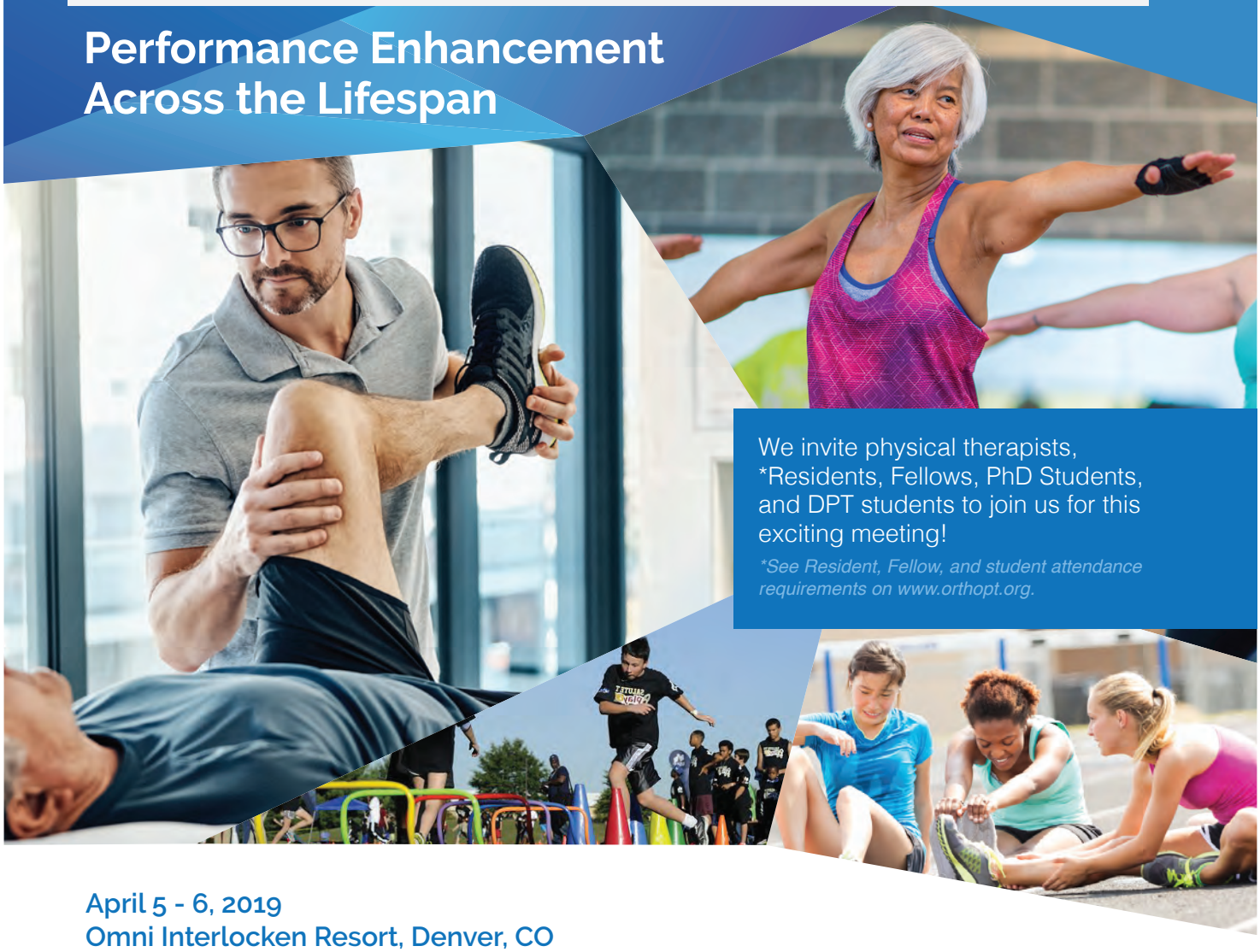

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Orthopaedic physical therapists treat patients across the lifespan and are committed to enhancing patient's physical and functional performance. The Academy of Orthopaedic Physical Therapy's 2019 Annual Orthopaedic Meeting will explore this responsibility specifically in the areas of rehabilitation dosing and patient mobility. From recovery after ACL injury and complications after total knee arthroplasty to assessment and training mobility in older adults, the team of experts will integrate best available evidence in hot topic areas and enhance participant learning with exciting and hands on laboratory breakouts.

On Day 1 of the program, participants will recognize the key challenges that face adolescents and young adults with ACL injury, recognize the impairments and the best evidence based interventions to mitigate risk and enhance their outcomes, and maximize their protection from re-injury and long term complications.

On Day 2, the unique role of blood flow restriction as an innovative exercise approach will be explored from the acute post-operative time period through the inevitable sarcopenia in geriatrics. The treating therapist will be inspired to enhance mobility of their older adult patients, rediscover how to evaluate and re-design mobility enhancing rehabilitation programs. The participants will also gain the knowledge and manual therapy skills to maximize mobility after total knee arthroplasty. This 2-day event will inspire therapists to question what they do and embrace what can be done as we enhance patient performance across the lifespan!

Schedule: Day one

Friday, April 5, 2019
7:45 am – 5:30 pm

General Session: 7:45 AM – 10:15 AM

General Session Titles:

- Role of the Physical Therapist in Targeting Risk of ACL Injury
- Population Specific ACL Injury Prevention and Dosing
- From the Clinic to the Field: Maximizing Functional Recovery after ACL Reconstruction
- ACL injury begins with "A" and ends with "OA:" potential to change the outcome begins with you
- Prevention of 2nd ACL injury in your current rehabilitation episode of care: Are we doing enough?

Speakers:
Kevin R. Ford, PhD, FACSM; Jeffrey Taylor, PT, PhD, DPT, OCS, SCS, CSCS; Mark V. Paterno, PT, PhD, MBA, SCS, ATC; Laura C Schmitt, PT, MPT, PhD

Visit www.orthopt.org to view the key topics addressed during this general session

Concurrent Breakout Sessions:

Following the general session on Friday, four concurrent breakout sessions will be offered. The registrant will attend *three out of four* breakout sessions following the morning general session, based on order of preference indicated on the registration form. Note: space is limited, therefore attendee's breakout sessions are assigned on a first-come, first-serve basis.

Breakout Session 1:

Hands-on Techniques to Provide Screening and Feedback to Reduce Risk of Primary ACL Injury
Kevin R. Ford, PhD, FACSM

Breakout Session 2:

Exploring the Role of the PT in Field-based Primary ACL Injury Prevention and Rehabilitation Dosing with Wearable Technology
Jeffrey Taylor, PT, PhD, DPT, OCS, SCS, CSCS

Breakout Session 3:

Objectively-informed Decision-making to Maximize Functional Recovery
Laura C Schmitt, PT, MPT, PhD

Breakout Session 4:

Targeted Rehabilitation to Reduce 2nd ACL Injury:

Addressing Risk Factors at all Phase of Rehabilitation
Mark V. Paterno, PT, PhD, MBA, SCS, ATC

Friday April 5, 4:30 pm - 5:30 pm:

"Eureka Hour"

The last program of the day on Friday will be a hot off the presses, evidence rapid fire "5 slides in 5 minutes" session! Plan to stick around for these research presentations and a Q&A wrap-up before our networking reception. Come join the dialogue!

Networking Reception: 5:30 – 7:30 PM

Schedule: Day two

Saturday, April 6, 2019
8:00 am – 4:30 pm

General Session: 8:00 am – 10:30 am

General Session Titles:

- Performance Enhancement Using Blood Flow Restriction Training: From Athletes to Older Adults with Sarcopenia
- Challenges, Clinical Reasoning, and Innovations in Total Knee Arthroplasty
- The Older Adult: How to Guide for Mobility Assessment and Advanced Clinical Decision Making
- Task-oriented Motor Learning Approach to Walking: From Athletes to Older Adults, the Aim is Expert Movers

Speakers:
Johnny Owens, MPT; Michael Bade, PT, DPT, PhD, OCS, FAAOMPT; Jennifer Brach, PT, PhD; Jessie VanSwearingen, PT, PhD, FAPTA

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Concurrent Breakout Sessions:

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Breakout Session 5:

Clinical Application of Blood Flow Restriction Exercise Lessons Learned from the Lab
Johnny Owens, MPT

Breakout Session 6:

Key Manual Therapy Techniques and Strategies for Maximizing Movement after Total Knee Arthroplasty
Michael Bade, PT, DPT, PhD, OCS, FAAOMPT

Breakout Session 7:

Measuring Mobility Goes beyond Gait Speed: Get Up and Do it!
Jennifer Brach, PT, PhD

Breakout Session 8:

Science and Practice – How to Restore the Motor Skill of Walking from Both Sides of the Street
Jessie VanSwearingen, PT, PhD, FAPTA

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Rehabilitation Outcomes Following Primary vs Secondary Repair of Ruptured Tibialis Anterior Tendon: A Report of Two Cases

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ABSTRACT

The article presents two case reports of patients rehabilitated in the outpatient setting following primary and secondary repairs of the tibialis anterior tendons after a complete rupture. Both patients had varied predisposing factors. The presence of a dorsiflexion lag during gait was an important postoperative and post-rehabilitation deficit that has implications on gait and fall risk for patients and hence clinical practice for the outpatient physical therapist.

Key Words: dorsiflexion lag, primary and secondary tendon repair, fall risk, gait

The incidence of tibialis anterior rupture followed by repair and rehabilitation is uncommonly found in the literature. The tibialis anterior is the primary dorsiflexor of the foot along with the extensor hallucis longus and the extensor digitorum longus. Acute tibialis anterior ruptures typically occur when there is a strong eccentric contraction. The patient will often report feeling a 'pop'. Acute ruptures are more common in younger individuals. Chronic injuries are more attritional in nature. The subjects complain of a gradual development of a slapping foot or difficulty clearing the floor when walking. It is usually without antecedent of trauma. It is more common in the older population.[1]

Patient 1 was a 71-year-old male with a personal medical history of diabetes mellitus, hypertension, and a BMI of 39.9. He presented to the orthopedic surgeon with complaints of "slapping" of his left foot when walking. He reported his symptoms had been present for approximately 2 months, without any trauma or other apparent cause. He believed that his symptoms could possibly be related to a diabetic neuropathy prior to seeing the surgeon. The MRI findings showed a complete rupture of the tibialis anterior tendon with retraction above the level of the extensor retinaculum.

The surgical repair required the use of a cadaveric tibialis anterior tendon graft with anchor due to the nature of the rupture. The patient was immobilized postoperatively, initially in a fiberglass cast, fixed at 90° for 3 weeks and 5 days, nonweight bearing. He was subsequently transitioned to a CAM boot, partial weight bearing to full weight bearing as tolerated. He continued weight bearing in the CAM boot using a straight cane for another 3 weeks. The total immobilization time from surgery was 7 weeks and 5 days. Patient findings following immobilization are found in Table 1. Upon discharge of the CAM boot the patient was fitted with a lace up ankle brace. The postoperative protocol can be found in Table 2.

The patient began physical therapy at approximately 6.5 weeks following his surgery. His treatment comprised initially of modalities as needed and therapeutic exercises with the goal of improving his ankle passive range of motion in all planes and strength for inversion, eversion, and plantar flexion. Hip and knee strengthening exercises to help improve ambulatory function were also initiated. Active dorsiflexion strengthening was initiated at 8 weeks postoperatively. Additionally he received functional electrical muscle stimulation (FES) to the anterior tibialis muscle. The patient received 17 sessions of therapy over a period of two months. Upon discharge the patient was independent in all weight-bearing activity without assistive device. He reported overall improved ambulation. However, he reported fatigue at the end of the day with some foot slap at that time which also was progressively improving. It should be noted the patient did not gain full active dorsiflexion to end range. The surgeon attributed this to a loss of mechanical advantage as a result of the change in tendon length.

Patient 2 was a 73-year-old male with a BMI of 25.4. He presented to the orthopedic surgeon with complaints of weakness in his right foot due to perceived foot slap during walking. He reported that he was not sure when his 'slapping' of the foot began but he noticed it after he had been working on his bathroom floor on his hands and knees. He had notable difficulty picking up his foot to walk when he got off the floor and was unable to recall with certainty if he had been on a plantar flexed foot when kneeling. His post examination MRI done by the orthopedic surgeon showed a complete rupture of the tibialis tendon (Figure 1).

The patient underwent a primary repair of the tibialis anterior tendon that involved reattachment and reinforcement with an AmnioGraft. He was placed in a CAM boot in a nonweight-bearing status for 6 weeks followed by weight bearing as tolerated also in the boot.

The patient began physical therapy 6 weeks postoperatively. All phases of his therapy protocol (Table 3) were specified by his surgeon based on the repair and physiological healing. All changes and progression to protocol were provided by his surgeon during the postoperative follow-ups.

Upon evaluation, the patient presented with a well healed surgical incision on the right foot with mild swelling of the dorsum of the foot. His gait was asymmetrical due to the boot. His range of motion and strength measures are found in Table 4.

At the time of discharge from physical therapy, the patient had received 20 sessions over approximately 10 weeks. Functionally, the patient was able to ambulate without a limp. He was able to complete all activities of daily living, including lawn mowing, driving, and small errands without difficulty. He could negotiate stairs without tripping. He complained of occasionally feeling like

Table 1. Patient 1: Postoperative Evaluation Findings (7 weeks post)

Right Ankle	Passive Range of Motion	Strength (MMT)
Dorsiflexion	Neutral, with complaint of stiffness	Not assessed, active dorsiflexion was noted
Plantar flexion	Within Normal Limits	4/5, without complaint of stiffness/pain
Inversion	10°, without complaints	4/5, without complaint of stiffness/pain
Eversion	10°, without complaints	4/5, without complaint of stiffness/pain

Table 2. Patient 1: Postoperative Rehabilitation

Weeks 1-6	CAM boot	Nonweight bearing	No physical therapy ordered	Physical therapy routine
Week 7	CAM boot	Weight bearing as tolerated initiated physical therapy.	Passive ROM only by physical therapy, all planes except plantar flexion	Rocker, resisted tubing plantar flexion, inversion, eversion. Cybex knee extension and flexion isotonic strengthening in CAM boot.
Week 8	Initiate lace up brace	Full weight bearing	Continue passive ROM as above Added weight bearing exercises with brace	Rocker, resisted tubing as above. Seated active dorsiflexion Step up, step down on 6" step. Cybex knee extension and flexion strengthening in lace up brace.
Week 9-10	Continue lace up brace	Same as above	Initiated simple stability exercises	Single leg stance, standing active dorsiflexion.
Week 11-12	Wean off lace up brace per MD orders	Same as above	Increased body weight exercises	Squats, sit to stand, standing lunges on step to self-mobilize ankle.
Week 13-14	No brace	Same as above	Progressed reps, sets on lower extremity strengthening	
Week 15	No brace		Patient discharged from therapy	

Abbreviations: MMT, manual muscle test; WNL, within normal limits; CAM, controlled ankle motion; ROM, range of motion

his toes caught the floor but this was inconsistent and he denied any falls. However, he acknowledged a fear of falling and challenge with the balance training during physical therapy. As part of discharge evaluation, the patient was asked to actively dorsiflex in standing (mimicking a heel strike) with his back against the wall, essentially attempting to test dorsiflexor strength in standing through full range. There was approximately a 10° lag versus the nonsurgical leg.

At a one year follow-up, both patients reported feeling very satisfied with their surgery and rehabilitation. Both continued to have occasional catching of the foot, mostly at the end of the day, but had not had any falls. Both patients were able to complete their daily routine without limitations.

Figure 1. Arrow points to empty tendon sheath of tibialis anterior.

DISCUSSION

A retrospective study by Kopp et al[2] of 10 patients, treated operatively for tibialis anterior ruptures and used the American Foot and Ankle Society (AOFAS) Ankle Hindfoot scale and isokinetic testing, concluded that although patients in the study were satisfied with their functional outcomes, isokinetic testing showed decreased dorsiflexion and inversion strength compared to the uninjured side. A study by Ellington et al,[3] comprising of 15 tibialis anterior repairs; 5 primary repairs and 10 with tendon transfers, using dynamometry also concluded that there were significant differences between the dorsiflexion strength of the operated and uninjured ankles. However, they did not note a statistical difference between those treated with primary repairs vs. tendon transfers.

A literature review of 32 articles comprising of case reports of tibialis anterior tendon repairs from 1997-2012 that included 44 reported cases found that 69% had total recovery, 26% had moderate improvement, and 12% had complications.[4] The patients in this case series demonstrated a dorsiflexion lag and reported changes to their gait. A long-term follow-up with a larger patient

Table 3. Patient 2: Postoperative Rehabilitation Protocol

Weeks 1-6	CAM boot	Nonweight bearing	No physical therapy ordered	Physical therapy routine
Week 7	CAM boot	Weight bearing as tolerated initiated physical therapy	Passive ROM only all planes except plantar flexion by physical therapy	Home exercise program of heel slides, seated calf stretches
Week 8	Initiate lace up brace	Full weight bearing	Strengthening – plantar flexion, inversion, eversion. Added weight bearing exercises with brace	Rocker passive ROM, Elastic tubing resisted strengthening, seated stretches, Step up 6" step.
Week 9-10	Continue lace up brace	Same as above	Initiated active dorsiflexion, simple stability exercises	Initiated leg press, knee and hip strengthening Single leg standing, seated active dorsiflexion, standing calf stretch
Week 11-12	Continue lace up brace	Same as above	Increased body weight exercises	Squats, sit to stand, standing lunges on step to self-mobilize ankle
Week 13-14	Wean off the brace	Same as above	Progressed repetitions, sets on lower extremity strengthening	
Week 15	No brace		Patient missed this week of physical therapy due to an insect bite that caused swelling of the foot	Swelling resolved in a week
Week 16-17	As above		Initiated standing dorsiflexion strengthening	Supported standing active dorsiflexion. Reviewed home exercise program, discharged from physical therapy

Abbreviations: MMT, manual muscle test; CAM, controlled ankle motion; ROM, range of motion

Table 4. Patient 2: Evaluation Findings 6 Weeks Postoperatively

Right Ankle	Passive Range of Motion	Strength (MMT)
Dorsiflexion	0°	2/5
Plantar flexion	10°	3/5
Inversion	10°	3/5
Eversion	5°	3/5

group would be useful to study the effects of a dorsiflexion lag on other ankle and foot dysfunctions or pathologies.

CLINICAL APPLICATIONS

While a tibialis anterior repair may not be a commonly treated condition, therapists treating such a patient should attempt to maximize the return of full dorsiflexion range and strength to prevent an active or passive dorsiflexion lag. Factors that could influence development of a dorsiflexion lag include preinjury physical activity level, age-related changes of muscle strength and mass, and the loss of mechanical advantage as a result of surgical technique and tendon length change.

While neither patient in this study reported having fallen at their one year follow-up, each complained of fatigue with occasional catching of the foot. Both these factors could potentially lead to incidences of falls. As a primary dorsiflexor of the foot, the tibialis anterior plays a significant role in the ankle strategy. The ankle strategy is a primary contributor to the maintenance of static balance prior to the initiation of the hip strategy or stepping strategy.[5] In older patients this may influence their gait and may also increase the risk of falls. Hence, adequate dorsiflexion strength along with balance and proprioceptive training, both static and dynamic should assist in producing better patient outcomes. It was demonstrated that in these two cases, rehabilitation to improve range of motion, maximize strength as well as static and dynamic balance training was beneficial with the prevention of falls at one year follow-up.

Further studies with larger sample sizes are needed to determine possible differences between outcomes of primary and secondary repairs of the tibialis anterior. Follow-up studies on the incidence of falls in these patients are necessary to improve rehabilitative protocols and outcomes.

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Wooden Book Reviews

Rita Shapiro, PT, MA, DPT
Book Review Editor

Book reviews are coordinated in collaboration with Doody Enterprises, Inc.

ERRATUM

An error was noted in a book review printed in the last issue of *Orthopaedic Physical Therapy Practice*. The review titled, *Observational Gait Analysis: A Visual Guide*, Slack Incorporated, 2018, $71.95, ISBN: 9781630910402, 230 pages, Spiral Cover, Author: Adams, Janet M., PT, MS, DPT; Cerny, Kay, PT, PhD

Incorrectly cited as:

"The authors developed the observational gait analysis (OGA) and created the first edition of the Rancho OGA manual. Dr. Adams is a professor at California State University, Long Beach, Where Dr. Cerny has taught."

The text should have been written as:

"Dr. Adams and Dr. Cerny developed an abbreviated version of the original observational gait analysis method and Rancho manual pioneered by physical therapy staff under the direction of Dr. Jacquelin Perry in the mid-1960s. Dr. Adams is currently a professor at California State University, Northridge."

The Editor and reviewer regret the oversight.

Textbook of Kinesiology, Jaypee Brothers, 2018, $48
ISBN: 9789352704521, 227 pages, Soft Cover

Author: Bindal, V. D., PhD, LPT (USA)

Description: This book teaches basic kinesiology concepts. **Purpose:** The purpose is to incorporate into one book all the fundamentals of kinesiology and basic principles of human movement science. The author meets his objectives using three distinct sections to examine the basic concepts of kinesiology. **Audience:** The primary audience is students and educators in physical education and physical and occupational therapy. Although not specifically stated by the author, the book is most appropriate for undergraduate students and educators as an all-inclusive textbook on the basic concepts of human motion. It is written by an esteemed physical therapy educator and author. **Features:** The first of the book's three sections provides a historical review detailing the evolution of the field of kinesiology. It continues with a review of basic anatomical and physical fundamentals of movement that leads into basic biomechanical concepts. The book then dedicates nine chapters to kinesiology of each body region. These chapters contain a review of the origin insertion, actions of each muscle, and muscular interactions to initiate joint movement. The last section contains information on posture, basic principles of gait, kinesiology of daily activities, and kinesiology concepts in the prevention of injuries incurred during sports. A glossary of kinesiology terms concludes the book. **Assessment:** This is an all-inclusive, easy to understand, kinesiology textbook for undergraduate students and educators in physical education and rehabilitation sciences. It presents fundamental concepts of kinesiology while including detailed information about each joint and its muscular components. A key feature is the inclusion of a chapter introducing basic gait concepts. Since the purpose of the book is to provide basic concepts, licensed physical or occupational therapists will find the information redundant. The more advanced concepts of muscle activation and movement pattern coordination are beyond the scope of this book. Future editions would benefit from improved illustrations and links to online content. These changes would allow readers to better visualize the basic concepts of kinesiology and muscular interactions, as well as to compare normal and abnormal gait and posture. Despite these drawbacks, the book easily explains the fundamentals of kinesiology and movement science.

Jennifer Hoffman, PT, DPT, OCS
Select Rehabilitation

CLINICAL APPLICATION: PHYSICAL EXAMINATION PROCEDURE TO ASSESS HIP JOINT SYNOVITIS/EFFUSION

(Continued from page 31)

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PRESIDENT'S MESSAGE

Lorena Pettet Payne, PT, MPA, OCS

If you are looking for new learning opportunities, would like to network with peers or just take a refresher course, the OHSIG has been working for you. Combined Sections Meeting is in Washington, DC, on Saturday January 26, 2019, at Walter E. Washington Convention Center, room 146A. Please join your peers for the OHSIG membership meeting at 6:45 a.m., immediately followed by "Thinking Outside the Box: Improving Worker Health with Ergonomics" - 8:00-10:00 a.m. The OHSIG Board will be meeting on Wednesday, January 23, 2019, 6:00-9:00 p.m., Marriott Marquis, Pentagon room. Members are always welcome. Another opportunity to elevate your knowledge is at NEXT, Chicago, Illinois Friday, June 14, 2019 at 3:00 p.m. – Putting Science Behind the Promotion of Function to Support a Healthy Workforce. Additionally, check out the recent webinars presented by Steve Allison on Functional Capacity Evaluations and another on Job Analysis- Physical Demands Validation. These can be found with other archived podcasts on the OHSIG web page in the Academy of Orthopaedic Physical Therapy website at orthopt.org.

A big thank you to all of the members that have reached out to the OHSIG for answers, with concerns, for information, or have offered a greater level of involvement within the group. My passion revolves around the ability of individuals to participate in meaningful work which in turn leads to healthy, productive communities. My hope is that some of my enthusiasm and commitment is reflected in the work that board and many committee members have accomplished over the past 6 years. As I step away from my obligations as OHSIG President I want to review the objectives and progress which have served as our road map to the present and can continue to guide this dynamic group into the future.

Objective 1: Position PTs as leaders and valuable contributors to workers' compensation / occupational health

- The Work Rehab CPG is a non-traditional CPG in that it is not based on a specific pathoanatomic model. We anticipate publishing date in 2019.
- Direct access with payment under work compensation remains an area that needs work and the initiative of members from all chapters.
- The operational definitions have a new name, Current Concepts in Occupational Health. The Functional Capacity Evaluation, Ergonomics, Rehab of the Acutely Injured Worker, and Educators tool box are updated as of 1-2019.
- Increased awareness of physical therapist in the work space among policy makers, regulatory agencies has grown. Representatives from the OHSIG have met with the Department of Labor, OSHA administrators, members have communicated with Social Security administration, we have given comment on ACOEM guidelines, members have presented at national meetings of self-insured employers. We have submitted member names to represent the profession on various advisory panels. The OSHIG collaborates with the APTA Practice Department to keep in touch with policy makers and regulators.

Objective 2: Ensure physical therapists are aware of and compliant with workers' compensation regulations (including WC, ADA, OSHA, EEOC etc.)

- The OHSIG has sponsored webinars on OSHA first aid rule and continues to share information as available.
- The OHSIG has made available a secure social network platform that has hosted conversation regarding payment and policy.

Objective 3: Educate PTs in best practices for managing workers with health conditions

- Work Rehab CPG as cited above.

5S Your Work Place! - Adopting Lean Manufacturing Philosophy for the Health of the Work Force

Submitted by Lorena Pettet Payne

Like many of my colleagues, I am on-site at numerous work places that range from manufacturing to service, to health care and retail operations. Several years ago, I was at a client company when I noticed a piece of paper posted at a work station with this simple admonition "5S your work space." I questioned the individual regarding the sign. She cited the various activities that keep the area efficient, most of which originated from her and her teammates. She explained that consistent and convenient organization of her work area and making sure tools are in good working order helps her company remain efficient and, she admitted, it makes her happier.

"Just in time" manufacturing or more commonly referred to as lean manufacturing is based upon the Toyota production system structure and philosophy, which gained the attention of manufacturers in the 1960s. The Toyota Way includes 14 major principles that the company has been built upon.[1] A similar philosophy is Six Sigma with origins within the Motorola Corporation in 1980. Lean management is focused on eliminating waste and ensuring efficiency while Six Sigma's focus is on eliminating defects and reducing variability using statistical analysis.[2]

5S is a critical process that is included in the broader approach of lean management and will be introduced here. This same approach can easily be adapted by physical therapists on the job site and in clinical practice to improve the value of services to all clients and patients. When applied to physical therapist practice in injury prevention, ergonomic intervention, return to work decisions as well as more routine clinical services, the process of implementing all phases can be enlightening and, in the end, improve effectiveness.

5S Phases[3]

1. Sort (Seiri) Getting rid of unnecessary items
2. Set in order (Seiton) Placing all necessary items in the optimal place
3. Shine/Sweep (Seiso) Cleaning and inspecting the work place, tools, and machinery
4. Standardize (Seiketsu) Standardize the processes used to sort, order, and clean
5. Sustain/Self discipline (Shitsuke) Autonomous continuation of the processes

SORT: Simple observation in a work area can identify if there are tools that are not needed or obsolete in the work space. This can be distracting and may pose hazards if it limits the access to needed tools or supplies. Using information from the worker, make sure that all items are easily available, unused, or unnecessary items are removed.

SET IN ORDER: This is the important phase for input from the onsite physical therapist. Arrangement of the work area is critical to avoid wasted or unnecessary movements. Critical assessment of the material handling tasks including horizontal reach, lifting operations, and placement of supplies will expose activities that lead to needless injury. Recommendations for limiting reach distances or proper placement of heavier objects will be welcomed by the workers.

SHINE/SWEEP: Maintaining tools in good work order decreases the need for more force or awkward postures. Examples of this are not uncommon in my experience. I have seen workers using greater forces and awkward postures to complete a task when they are using dull blades on rotary cutters, worn out sand paper on palm sanders, and a malfunctioning door on a compactor.

STANDARDIZE: Communication of best practice is the first step to maintaining consistent quality or outcome. Physical therapist involvement in the orientation of new employees assists the company by giving consistent messages related to safety standards. Ergonomic principles, safety expectations, and reminders of general personal health management can be introduced and reinforced at each follow-up visit to the site. This phase reinforces the first 3 phases.

SUSTAIN/SELF DISCIPLINE: Sustaining the process includes continual re-evaluation of efficiency and effectiveness. Physical therapists can identify areas of higher incidence of injury, investigate the cause, and recommend a change in the work area set up or in the tool used. This may produce a new standard with input from the workers and management which in turn will need to be sustained.

5S is only a small part of lean management philosophy. Lean management is nimble and responsive to all customers. Kaizen means "change for better" and is a perpetual concept that lean companies embrace. It humanizes the workplace while eliminating overly hard work (Muri). That is where physical therapists have so much to offer any business. It should not be overlooked that we should inspect our own business practices, implement lean management thinking if only the 5S phases to become more effective, producing a product that all of our customers value.

There are a number of resources related to lean management. The business school near you may have short courses on the subject. Explore numerous books published on "the Toyota way" and become familiar with the fourteen principles[4] on which efficiency can be built.

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President's Letter

Annette Karim, PT, DPT, PhD
Board-certified Orthopaedic Clinical Specialist
Fellow of the American Academy of Orthopaedic Manual Physical Therapists

As we move forward into 2019, I would like to invite you to join us at the following PASIG events before, during, and after CSM:

2-day CSM Preconference Course

Musculoskeletal Sonography of the Lower Limb Focused in Sport & Performing Arts, Tuesday 1/22 & Wednesday 1/23, 8:00 a.m. - 5:00 p.m., Convention Center, 147A

This 2-day hands-on course will provide an introduction to the use of diagnostic ultrasound, evaluation of the lower limb, and sonoappearance of lower limb pathology with specific consideration to the sports and performing arts population. Day 1 content will be suitable for those with no ultrasound experience, or as a revision for intermediate users. Day 2 will discuss in depth musculotendinous and bony pathologies and their sonoanatomy as it pertains to the hip, foot, and ankle. Attendees will learn how to integrate the information obtained through musculoskeletal sonography to enhance their clinical examination and overall improved patient satisfaction and outcomes. At the completion of this course, attendees will demonstrate understanding of the use of diagnostic ultrasound in a clinical physical therapy setting, including a basic knowledge of lower limb ultrasound evaluation and a comprehensive understanding of the sonoappearance and examination of musculotendinous and bony lower limb pathologies. Presenters will include *Megan Poll, Doug White, Marika Molnar,* and *Scott Epsley*, who have extensive experience in the use of real time ultrasound imagery in augmenting the clinical examination of athletes and performing artists.

PASIG Membership Meeting

Thursday, 1/24, 6:45 a.m. - 7:30 a.m., Convention Center, 146A

You do not need to be a member to join us at this early meeting. We would LOVE for you to become a PASIG member, but all are welcome. Please contact me if you have any questions.

PASIG Educational Session

Olympian to Novice: Using Evidenced-based Screening for the Performing Artist, Thursday, 1/24, 8:00 a.m. - 10:00 a.m., Convention Center, 146A

The importance of primary prevention for injuries in performing artists is necessary, as most injuries are related to overuse. The Performing Arts Rehabilitation group is developing and adapting current screening tools to provide a comprehensive approach to working with all performing artists, such as dancers, musicians, theater performers, vocalists, figure skaters, and gymnasts. Disseminating information found in screenings from the clinicians to the performers is integral to creating change and assisting with injury prevention. Development of home programs and educational tools, including videos, websites, and other instructional aids such as mobile applications, is helping physical therapists to reach patients and create better adherence to prescribed exercise. Presenters will be *Kristen Schuyten*, PT, DPT, MS, Board-certified Sports Clinical Specialist who was the physical therapist who traveled to PyeongChang for the 2018 Olympics with Team USA for Figure Skating, and C*orey Snyder*, PT, DPT, Board-certified Orthopaedic and Sports Clinical Specialist.

The following meetings will be held in our AOPT bonus room. Please note the time change.

PASIG Fellowship Taskforce Q&A Thursday 1/24 12:00 p.m. -1:00 p.m. (If interested, contact Laurel Abbruzzese, Fellowship Taskforce Chair)

PASIG Outreach Committee Thursday, 1/24 1:00 p.m. - 2:00 p.m. (If interested, contact Marissa Schaeffer, Outreach Chair)

PASIG Dancer Screening Networking/Q&A Thursday, 1/24 2:00 p.m. - 3:00 p.m. (If interested, contact Mandy Blackmon, Dancer Screening Chair)

PASIG Committees and Interested Volunteers Thursday 1/24 3:00 p.m. - 5:00 p.m. (Please contact the chair of the committee you are interested in)

2-day Post-conference Course, (AOPT-PASIG and University of Delaware co-sponsored)

Emergency Medical Response Full Course (2 days) Sunday, 1/27, 8:00 a.m. - 5:00 p.m. and Monday, January 28th, 8:00 a.m. - 4:00 p.m. (CEU Hours: 45)

Re-certification (1 day only for those expired ≤ 3 months) Sunday, 1/27 9:00 a.m. - 2:00 p.m. (CEU Hours: 7) https://sites.udel.edu/ptclinic/2019-emergency-medical-response-course-2/

Please contact Rosie Canizares, our Vice President and Education Chair, if you are interested in attending this post-conference off-site course: rcc4@duke.edu

A shout out to our PASIG members and OSU Performing Arts Fellows Tessa Kasmar and Tiffany Marulli presenting "Special Considerations for the Dancer: Meeting the Needs of an Athlete and Artist" at the 2019 NEXT conference in June.

Please get connected. The PASIG is you, me, and everyone we can grab along the way to create something new. Reach out to one of us! Stay tuned for updates on PASIG programming, dancer screening, fellowship, and membership in the monthly citation blasts and in our social media leading up to CSM. To belong to our Facebook page, contact Dawn (Muci) Doran, and please tweet about performing arts with us @PT4PERFORMERS

It is with great pleasure that I introduce Megin Sabo John, PT, DPT, OCS, author of the following study. Thank you, Megin, for your contribution to our profession.

Ischial Tuberosity Avulsion Fracture in an Adolescent Dancer: A Case Report

Megin Sabo John, PT, DPT, OCS
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INTRODUCTION

Adolescent and young adult athletes suffer apophysitis and avulsion fractures in various lower extremity locations, including the metatarsals, tarsals, tibia, fibula, femur, and pelvis.[1] Reportedly, these injuries are most common during a growth spurt,[2-4] and are associated with increasing tension force through the musculotendinous unit, thus placing increased pull at ossification centers.[4] An ischial tuberosity avulsion fracture is a disruption of the open apophysis at the hamstring insertion to the pelvis.[5,6] When placing the hamstring in extreme range of motion, increased tensile force through the musculotendinous unit often causes this injury.[5]

When adolescent dancers increase participation in athletic activities,[4] overuse injuries often occur at their tendons and apophyses.[4,7,8] Bowerman et al reports lower extremity injuries as the most common injury in young elite ballet dancers but found a lack of evidence clearly isolating growth, maturation, and poor lower extremity alignment as risk factors to the onset of overuse injuries in this population.[9]

Pediatric athletes are at risk of injury to their ossification centers, with ischial tuberosity (IT) cases reported most frequently.[9,10] Rossi and Dragoni[10] collected 203 cases of acute avulsion fractures in the pediatric athlete, over 50% of the incidents (109), reported to be IT injuries. In a systematic review of avulsion fractures in the pelvis, Porr et al[11] found the mechanism of injury poorly reported among the 66 case reports reviewed, making it difficult to link primary causes of injury to eccentric loading. However, they confirmed that 88% of those cases were associated with physical activity, most frequently with kicking and running.[11]

Diagnosis of IT avulsion fractures is typically done with a series of anterior-posterior (AP) radiographs and physical examination.[5,11-15] Tenderness to palpation over the IT and pain at the IT with manual muscle testing are common findings.[5,6,12,13,15] The literature offers limited protocols for conservative rehabilitation of IT avulsion, but describes common themes[5,6,16,17]: limiting stress at the injury site during the initial stage of nonsurgical rehabilitation[5,11-13,16-18] and avoiding vigorous or dynamic stretching until weight bearing is painfree and range of motion is restored.[5,6,12,14] Some authors advocate for a period of reduced or nonweight bearing on the affected side to minimize tension[6,17,18] while others advocate bed rest for the first 72 hours.[5] After painfree activity has been achieved, return to sport may be initiated.[5,6,12,16,17]

When evaluating hamstring injuries in adolescent dancers, apophyseal injuries are an important differential diagnosis.[5,6,17] These injuries can result from stretch-type passive movements, such as anterior-posterior splits, as well as forceful contraction-type movements, such as kicks and leaps.[5,17,19] Individuals frequently report a "pop" with associated pain near the IT, similar to athletes diagnosed with hamstring strains,[19] underlining the importance of early diagnosis with physical examination and radiographs, especially in management of the skeletally immature patient.[14] The purpose of this retrospective case report is to describe the interventions used during a progressive, full weight-bearing physical therapy rehabilitation program for an IT avulsion fracture in an adolescent dancer.

CASE REPORT

Evaluation

The patient was a 14-year-old female dancer participating in multiple dance genres in a Minnesota dance studio. She came as a referral from a local sports and orthopedics walk-in clinic with a right adductor/hamstring strain. She reported pain at her right ischial tuberosity that had subsided only minimally since the injury two weeks prior to the evaluation. She was not taking anti-inflammatory medications and had not participated in dance since the injury. She reported feeling a painful pull during her stretches, followed the next day by an audible pop and pain while doing anterior-posterior splits with the right leg forward. She reported no relevant medical history. During the evaluation she rated her pain as high as 6/10 intermittently with walking, sitting, lifting her leg into flexion, squatting, and bending forward. Her self-reported functional limitations also included dancing and running.

The patient had a slight antalgic gait with decreased stance phase on the right lower extremity. Her pelvis was level in standing, and she could bend and reach the floor but reported pain over her right ischial tuberosity. She had no pain with adductor stretching or with resisted adduction. Measured with a single inclinometer placed mid-tibia (Figure 1) and allowing the hip to abduct slightly at end range, her uninjured left leg had hamstring flexibility during

Figure 1. Inclinometer placement for straight leg raise measurement.

a straight leg raise (SLR) of 130°. She had limited range of motion during the right involved SLR of 90° due to increased pain at the IT. Supine passive hip and knee flexion and active hip flexion during seated psoas manual muscle testing produced pain. She reported pain with prone right hip extension with the knee flexed but was able to hold against approximately 50% maximal contraction with 4-/5 strength during manual muscle testing (MMT) as compared to the uninvolved side. She had 4/5 strength on the right hamstring with prone MMT but with reported IT pain. She had tenderness to the musculotendinous unit of the hamstring and over the IT. All other hip, sacroiliac, and lumbar special tests were negative bilaterally including hip scour, FABER, FADIR, sacroiliac provocative tests, neural tensioning, and lumbar central posterior to anterior mobilizations.

The patient had signs and symptoms consistent with an avulsion fracture at the right IT with a possible hamstring strain. Positive findings included her age,[6] a "pop" during her stretching routine,[6,18] pain at the IT with active and passive hip flexion,[6] and tenderness over the IT.[5,6,12,13,15] She was referred back to her referring provider for additional work-up including plain radiographs.[6] The patient and parent were educated on the pathology findings and the referring medical provider was contacted to discuss findings of the physical examination.

Her plan of care recommended that she be seen twice a week for 6 weeks, then once a week for 4 weeks. Emphasis would be placed on neuromuscular re-education; therapeutic exercise; proprioception; balance; strengthening; and manual therapy to increase tissue extensibility, decrease muscle tension, and increase range of motion (ROM).

Differential diagnosis of an avulsion fracture could not be ruled out until review of radiograph results; therefore, aggressive stretching of the right hamstring was avoided. The referring provider ordered initial AP radiographs 19 days after the initial injury, resulting in confirmation of a 1 mm avulsion fracture of the right tuberosity growth plate at the hamstring insertion. Conservative nonsurgical treatment was recommended since the avulsion was minimally displaced.[6]

Interventions

Direct interventions during her initial examination (Table 1) included cross friction soft tissue mobilization of the right proximal hamstring musculotendinous unit. This approach reduces tension at the IT while maintaining mobility of the hamstring musculotendinous unit[20] and preventing adhesions.[20,21] This was followed by very gentle stretching of the right hamstring in supine and ice massage[22] over the ischial tuberosity and proximal hamstring. Furthermore, prone hamstring curls with independent concentric movements and assisted eccentric lowering with the other foot due to pain with independent lowering were initiated.

Initial interventions (weeks 2 to 7) implemented a period of relative (active) rest to prevent atrophy[23] and to encourage patient compliance with activity modification.[24] These interventions included Pilates, floor barre, and core strengthening[24] with full weight bearing as tolerated. In terms of tissue loading, active rest, and restoring ROM principles of progressive loading guided intervention planning.[25]

Approximately 4 weeks after the injury at her fourth visit, treatment progressed to partial loading with supine hooklying bridging using a posterior pelvic tilt[26] to reduce hamstring tension (Figure 2). Calf and adductor strengthening was initiated in standing barre exercises, including heel raises and ball squeezes between knees. Neuromuscular re-education was incorporated during week 4 with Pilates based small leg circles in supine with the injured leg at 90° of hip flexion. Hamstring stretching and bridges with alternating march were included at this phase due to 0/10 pain reported during these activities.

Week 5 progressed to Pilates based sidelying strengthening exercises (clamshell, bent knee abduction, and high clamshell) as well as prone knee-straight hip extension exercises with a focus on gluteus maximus activation. At this point she had increased passive ROM to 105° SLR on the right and decreasing levels of pain. At this time, her mother reported that at her yearly physical she presented with 5 inches of height growth in one year. A dramatic growth spurt such as this could result in increased tensile

Table 1. Intervention Progression

Weeks postinjury and visit count	2-3 weeks 3 visits	4-5 weeks 3 visits	6-7 weeks 3 visits	8 weeks 2 visits
Right SLR ROM	90°	90°	98°-120°	133°
Intervention	Hamstring frictions at MTJ, Gentle Seated HS stretching, Ice Massage, Active-assisted ROM for prone hamstring curls	Hamstring frictions at MTJ, Bridging floor and ball, Heel raises, Adductor ball squeezes, Pilates leg circles in supine, Sidelying hip strengthening	Week 6: Hamstring frictions, Continuation of previous exercises Week 7: No manual treatment, Bridge walkouts, Pilates supine leg scissors, Hamstring curls on ball	Airplane balance, Balance with passé and developpé, Roman dead lifts, Single leg hip extension knee bent to 90°, Nordic curls, Pilates: rollover, jackknife, scissors, & leg circles
Pain Rating	6/10	4/10 sitting	Not rated	2/10 end range and grand plié
Posttreatment SLR ROM	Not tested	Week 5: 105° Right 125° Left	105° - 125° Right	Not tested

Abbreviations: SLR, straight leg raise; ROM, range of motion; MTJ, musculotendinous junction

Figure 2. Bridge with posterior pelvic tilt cuing.

force at the apophysis making her more susceptible to an avulsion injury.[27]

At 7 weeks postinjury, she reported low levels of pain; while stretching she rated her discomfort at 2/10. Her SLR measured 120° on the right and 130° on the left. Manual muscle testing of the hamstring in prone with knee bent at 90°, revealed 5/5 static strength with no pain during eccentric loading. Strengthening was progressed at this point with bridge walkouts, core stability training with Pilates supine leg scissoring, and hamstring curls using a Swiss ball. Her SLR was near normal posttreatment measuring 125°.

Two months postinjury she measured 133° SLR on the right with 2/10 pain at the IT and 135° SLR on the left (Table 2). Exercise progression during weeks 8 and 9 included tall kneeling Nordic hamstring strengthening, Pilates core strengthening including jackknife and rollover exercises to incorporate hamstrings, end-range hamstring contraction with small ball squeezes in standing (Figure 3), "Airplane" balance,[28-30] (Figures 4 and 5) and single-leg dead lifts[31] for eccentric hamstring loading. Dance specific techniques were incorporated in balance exercises with passé développé movements into flexion, abduction, and extension. Return to dance progression was discussed with the patient and her mother, and she was encouraged to complete a daily 30-minute strengthening program for her core, hip rotators, and hamstring strengthening per initiated exercises. She was asked to rotate hamstring strengthening exercises every other day choosing among Swiss ball hamstring curls, single-leg dead lifts, end-range hamstring contraction with small ball squeezes in standing, Nordic curls, and bridge walkouts.

She had no pain with leaps or splits during week 9; therefore, progressive strengthening (Figures 6 and 7) and balance interventions continued. The following week she measured arabesque ROM (hip extension in standing) on the right leg at 70° of extension and 82° of extension on the left leg. The patient completed all stretching without pain and reported no pain with her home exercise program.

She had a setback at 11 weeks postinjury reporting increased pain to 3/10, primarily after completing her home exercise program. Her hamstring strength was 4+/5 with MMT in prone and knee bent to 90°; she reported ischial tuberosity pain with SLR and continued to have decreased SLR ROM at approximately 100° on the right during the 12th week. She was referred at 13 weeks for follow-up radiographs, which showed a small line present at the ischial tuberosity but no distinguished fracture. Manual therapy was introduced again at 11 to 14 weeks with emphasis on soft tissue release of the hamstring muscle belly and cross friction to adhesions within the musculotendinous unit.

Outcomes

She began modified dancing at 14 weeks postinjury with restrictions to the barre portion of ballet and tap dance classes. She began to independently manage her strengthening at 15 weeks with one

Table 2. Intervention Progression

Weeks postinjury and visit count	9-10 weeks 2 visits	11-12 weeks 2 visits	14 weeks 1 visit	15 weeks 1 visit	27 weeks (6 months) 1 visit
Right SLR ROM	Week 9: 135° Week 10: not tested	Week 11: 90° Week 12: 100°	Not tested	110°	122° Bilaterally no pain
Intervention	Roman dead lifts, Airplanes, Standing hamstring exercise with ball squeezes at variable speeds, Nordic curls, Single leg bridge, Ball Hamstring curls, Ball bridges, Down dog arabesque, Plank arabesque	Hamstring frictions, Ice massage, Stretch hamstring manually	Hamstring frictions, Contract/relax right hamstring	Airplane, Roman Dead Lifts, Swiss ball hamstring curls, bridges (all progressed with dynamic surfaces) Pilates: superman, rolldown, leg circles, leg pull up/down	Hamstring frictions, Hamstring stretch, reviewed hamstring curls on ball and bridges at various angles
Pain Rating	0/10	Week 11: 3/10 in muscle Week 12: 0-2/10	Not rated	0/10	0/10
Post treatment SLR ROM	Not tested	Slight increase	122° Right 137° Left	Not tested	Not tested

Abbreviations: SLR, straight leg raise; ROM, range of motion

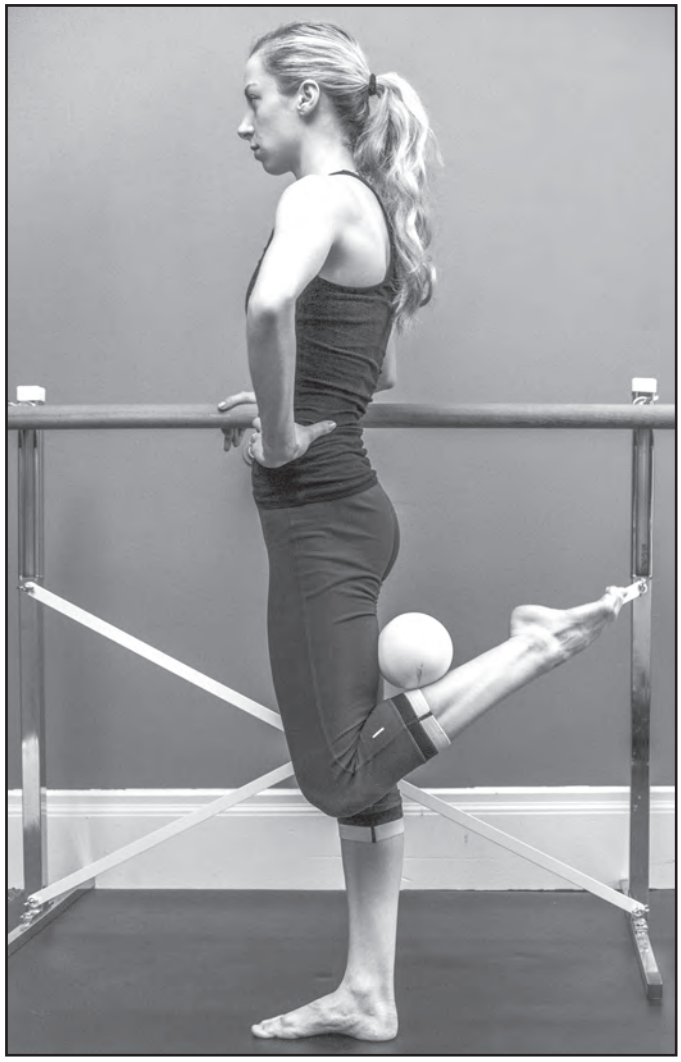

Figure 3. End-range hamstring contraction with small ball squeezes in standing.

Figure 4. Airplane balance.

returning follow-up visit at 6 months. She was still slightly limited to 122° of ROM during SLR on the right, but she reported no pain. She had decreased hamstring strength on the right in prone testing 4/5 and reported some hamstring soreness and fatigue with dance.

Discharge planning discussions with her and her mother

Figure 5. Airplane balance into plié.

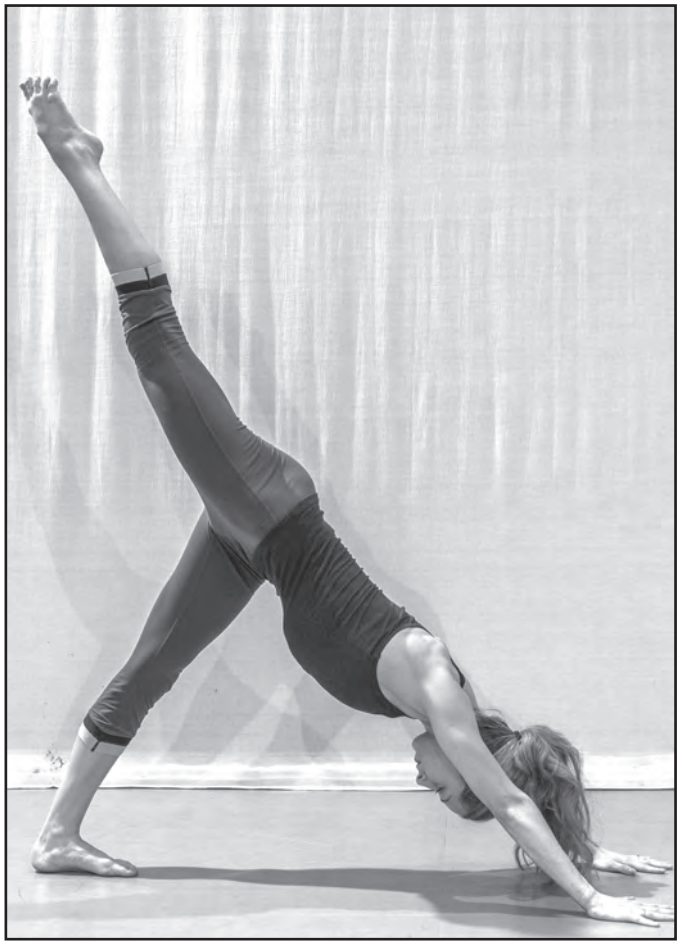

Figure 6. Downdog arabesque.

emphasized ongoing hamstring and core strengthening as previously prescribed. She did not require any additional visits although a follow-up visit was completed at 6 months.

DISCUSSION

Throughout the rehabilitation program the patient's mother reported financial concerns. This consideration impacted the treatment plan, resulting in reduced attendance, as the original recommendation was therapy twice a week for 6 weeks followed by once a week for 4 weeks. This change in frequency—despite patient education aimed to ensure the dancer followed guidelines for return to

Figure 7. Plank arabesque.

dance that included maintaining low level pain during stretching and strengthening—resulted in less guidance during more challenging exercise progressions. This could account for the dancer's increased pain and weakness at approximately 10 weeks postinjury as the dancer increased load on the hamstring by incorporating more dance-based movements at home. She reported compliance with the strengthening program but likely accelerated her home program too quickly due to lack of skilled supervision. Jumps and leaps were not introduced in the clinic, which may have been a contributing factor as well. More comprehensive neuromuscular re-education of her lower extremities, such as the dance specific jump protocol from the Harkness Center for Dance Injuries, as well as dynamic exercises for strength and agility could have been emphasized more toward the end of her rehabilitation. This case report demonstrates a progressive full weight-bearing conservative approach to IT avulsions in the skeletally immature patient, which could assist with further studies as well as clinical management of similar patients.

CONCLUSION

Progressive treatment of adolescent patients with IT avulsion fractures has been scantily outlined in the literature. While we know that athletes across various sports present with IT avulsions, we have no clear parameters for return to sport. We do know that stretch-type hamstring injuries in dancers tend to have longer healing time frames than sprinters,[32,33] which could be significant when treating an adolescent athlete with a stretch-type avulsion at the IT. The literature discusses eccentric loading for hamstring injuries, but there is still a lack of guidance concerning full weight-bearing physical therapy rehabilitation for an avulsion fracture with associated hamstring strain. This case report presents a conservative treatment for a 1mm avulsion fracture at the IT growth plate with return to dance at 14 weeks and full recovery reported at a 6-month follow-up. The progression of treatment and relative rest effectively returned this adolescent athlete to full athletic activity without reoccurring pain or injury and should be considered in patients with similar diagnoses.

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This edition of *Orthopedic Practice* will be landing on your desk right around the time of the Combined Sections Meeting 2019. This meeting always provides ample opportunity to catch up with colleagues, invigorate practice with some new ideas, and stimulate our thinking with current evidence. Two talks in particular were interesting as the FASIG started planning for the meeting in early 2018. First, the FASIG sponsored the educational program titled, "A Foot Core Approach to Treating Plantar Fasciitis" by speakers Irene Davis, PT, PhD, FAPTA; Sarah Ridge, PhD; and Lindsay Wasserman, DPT, FAAOMPT. The second talk was titled "Physical Therapist Management of Foot and Ankle Pain From Head to Toe," by Ruth Chimenti, PT, DPT, PhD; Beth Fisher, PT, PhD, FAPTA; and Mary Hastings, PT, DPT, ATC, MSCI. These two talks offer some great insight into two very diverse, but historical topics in foot and ankle care. Strengthening the foot has been a topic of debate for decades with seminal papers on muscle electromyographic activity in the foot dating back to 1963.[1] The focus on foot strengthening continues today with novel work on midfoot power during walking and running which continues to define the paradigm for the role of foot strength.[2,3] Equally historical and yet, also timely, is the discussion of pain pathology, impairments, and psychological factors.

The literature on management for plantar fasciitis over the past year has included systematic reviews on the use of laser therapy[4] and platelet-rich plasma,[5,6] while insight into mechanisms that might cause, or influence, plantar fasciitis such as gastrocnemius tightness[7] and muscle strengthening are evolving. Clearly, our clinical practice guidelines have advocated the use of stretching and strengthening in the management of heel pain.[8] Novel work, including that presented in regards to strengthening of the foot intrinsics, is sure to foster increased discussion and study on the topic of foot muscle strength in common foot conditions such as plantar fasciitis.

It is also a FASIG highlight to see the topic of pain neuroscience focused on common foot and ankle conditions. The influence of tissue-specific stress on movement and pain is familiar in our biomechanical literature[9] but has re-surfaced when compared and integrated into a biopsychosocial approach to pain.[10] Finally, the consideration of brain-behavior effects on our patient instruction was wonderful to see integrated into case studies.

I hope that you were either able to enjoy these talks at CSM personally, or will take a moment to review the slides posted online along with the supporting literature.

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President's Message

Carolyn McManus, MPT, MA

The Pain SIG Board has been busy! We received approval from the Academy of Physical Therapy Board to change our name to the Pain Special Interest Group. Thank you to all those who contributed time and energy to this process.

Pain SIG Practice Chair, Craig Wassinger, PT, PhD, has been actively involved in the development of the Clinical Practice Guideline (CPG) for Patient Education/Counseling to Treat Pain. The CPG team is currently working on the second phase of manuscript reviews. Nearly 15,000 manuscripts were initially reviewed and approximately 1500 selected for full text review. Over the next few months the team will extract relevant data and initiate the CPG writing process. Their goal is to have a manuscript published in late 2019 or 2020 and corresponding presentations at various scientific meetings in a similar timeframe.

In addition, Craig is a member of a newly formed APTA workgroup that aims to provide PT information and pain-related resources to patients, clinicians, and payors. Representatives from APTA Academies and Sections were invited to participate in his workgroup, coordinated by Hadiya Guerrero, DPT. The Pain SIG Board will keep members appraised of the workgroup's activities and provide members with the information and resources developed by the workgroup as they become available.

Pain SIG Public Relations Chair, Derrick Sueki, DPT, PhD, OCS, has spoken at the national, state, and local levels about the need to promote physical therapists as pain specialists and as such has advocated for physical therapy as the first treatment choice for people who have pain. While realizing that public and professional awareness is an important aspect in changing practice patterns, it is also important to identify clinicians who possess the skill set to treat patients with various types of pain. In this regard the Pain SIG, with the consent of the AOPT Board of Directors, has actively begun to take the steps necessary to explore the feasibility of a developing a Specialization Tract focused on the science and management of pain. If established, the Pain Specialty Certification would not only provide physical therapists with a means of demonstrating their advanced knowledge in the field of pain but would also provide the public and health care professionals with a means of identifying those physical therapists who specialize in the treatment of pain. This process is in its infancy and there are a number of steps needed to bring this to fruition. Stay tuned for more information as our efforts go forward.

Education Chair, Mark Shepherd, DPT, OCS, is coordinating the Pain SIG quarterly webinar series, Current Topic in Pain. Keep an eye out for information on this series that will launch in 2019.

This quarter, I have written an article on the topic of chronic stress, chronic pain, and the corticolimbic system. When I began practicing physical therapy in an outpatient orthopaedic clinic in the 1980s, I observed that patients who appeared highly stressed often had a slower and more complex recovery course than those who did not appear stressed. This sparked a career-long interest in this topic. As I continue to observe the impact of stress on patients with pain conditions and the frequently beneficial applications of stress reduction strategies, I have become curious about the underlying mechanisms that could explain my clinical observations. This article explores one proposed theory and its clinical implications. I wish to thank Derrick Sueki, DPT, PhD, OCS, for his thoughtful review and suggestions prior to submission for publication. For those with additional interest, Etienne Vachon-Presseau, PhD, from the Apkarian Lab at Northwestern University, and I will present on this topic at NEXT 2019 in Chicago this coming June.

Chronic Stress, Chronic Pain, and the Corticolimbic System

Carolyn McManus, MPT, MA

The contribution of adverse stress and psychological distress to persistent pain and disability has been proposed to impact a range of pain conditions. Multiple studies have begun to suggest the role of adverse stress on pain and disability.[1-8] In a prospective multicenter study of individuals who presented to the emergency department within 24 hours of motor vehicle collision, helplessness and anger were associated with initial axial pain severity while hyperarousal symptoms most influenced and partially mediated axial pain persistence in initial months post-collision.[1] In a community sample of older adults, higher scores on the Perceived Stress Scale were associated with greater pain intensity and interference.[2] In a study of women undergoing surgery for primary breast cancer, preoperative distress was significantly associated with moderate to severe persistent pain at 8 months.[3] In a cohort of patients presenting to a shoulder clinic, catastrophic thinking and decreased self-efficacy were shown to be associated with greater shoulder pain and perceived disability.[4] In addition, more severe stress symptoms was one of 3 factors predictive of activity limitation after 2 years in women with chronic low back pain in a primary health care setting.[5] It is also important to note, the relationship between psychosocial distress and disability in patients with pain is not universal.[9]

THE CORTICOLIMBIC SYSTEM

While evidence from clinical studies indicates a possible link between stress and pain, in recent years, research has also begun to offer insight into the cortical and subcortical mechanisms involved in this association. By examining regions of the brain in processing both stress and pain, clinicians can begin to consider how psychological stress and difficult life circumstances could influence a patient's symptoms and function. In addition, the unpredictable and uncontrollable features of persistent pain could contribute to an ongoing stress reaction and this, too, could potentially become an influencing factor in a patient's presentation.[10]

A substantial body of research has consistently demonstrated that the corticolimbic system is involved in the initiation, regulation, and termination of the stress reaction.[11,12] Key brain regions of the corticolimbic system include the prefrontal cortex (PFC), amygdala, and hippocampus. These brain areas are interconnected and influence each other through both direct and indirect neural

pathways.[11] While acute stress can elicit an adaptive physiological reaction that promotes survival, chronic stress can contribute to a dysregulation of the hypothalamic-pituitary-adrenal axis and disrupt the homeostasis of an organism.[10] When stress becomes chronic, the PFC, amygdala and hippocampus also show maladaptive neuroplastic changes and altered brain activity that impacts the down-regulation stress reaction.[11,12] Similar neuroplastic changes are present in some chronic pain conditions, leading to the proposition of a theoretical model for the role of stress-associated corticolimbic changes in the generation of chronic pain.[10,13] Below is a summary of stress and pain-related changes in the PFC, amygdala and hippocampus. They suggest a possible role for stress-associated corticolimbic changes in chronic pain conditions.

THE PREFRONTAL CORTEX

The PFC functions to generate the highest order cognitive abilities, including abstract thought, flexible goal-directed behavior, and the regulation of emotions.[12] Acute stress-related changes in the PFC have been observed in both rodent and human studies. Rodent studies suggest stress-associated release of catecholamines results in reduced neuronal firing in the PFC while simultaneously promoting an increase in activity in the amygdala.[12] This shift in neuronal activity contributes to the transfer of brain processing from a reflective control to a more habitual, reflexive regulation of behavior.[12,14] Chronic exposure to stress has been shown to contribute to additional structural changes in the PFC, including reductions in dendrite length, branching, and spine density.[12] These changes reinforce neurocircuitry that promotes a more primitive, habitual behavior over a slower, reflective one.[12,14] In human studies, chronic stress has been shown to impair attentional control, disrupt PFC functional connectivity, and impair the PFC regulation of the amygdala.[15,16] The number of adverse events a person has experienced and increased perception of stress have both been found to be related to decreased PFC volumes.[17,18]

Prefrontal cortex changes have been found in patients with chronic pain. Patients with chronic back pain demonstrate regional gray matter volume decreases in the PFC.[19,20] Atrophy of the ventromedial PFC gray matter is found in patients with complex regional pain syndrome.[21] Also, patients with fibromyalgia have been shown to have significantly less gray matter density in the medial prefrontal cortex and 3.3 times the age-related loss in total gray matter volume compared to healthy controls.[22] In addition, impaired prefrontal cortical function has been proposed to contribute to the amplification of amygdala-driven pain mechanisms.[23]

THE AMYGDALA

The amygdala plays a central role in emotional responses and affective states and has also been identified as a brain region involved in the emotional-affective dimension of pain and in pain modulation.[23] Chronic stress is associated with amygdala hyperexcitability and structural plasticity in rodents.[24,25] Neuroplastic changes observed in rodents under chronic stress conditions include dendritic hypertrophy and increases in spine density.[25] In addition, chronic stress dysregulates amygdala output to the prefrontal cortex, providing a mechanism by which chronic stress can lead to increased anxiety.[26] In humans, neuroimaging studies have demonstrated that patients with post-traumatic stress disorder (PTSD) have greater amygdala responsivity compared to controls.[27]

Increased amygdala activity is documented in both rodent and human pain studies. Electrophysiological studies in animals consistently identify increases in activity in the amygdala in models of arthritic and neuropathic pain.[23] In humans, arthritic pain has been shown to be associated with increased activity in the amygdala.[28] As patients with subacute back pain transition to chronic pain, the amygdala has been shown to demonstrate increased responsiveness to spontaneous pain episodes.[29] In migraine patients, altered functional connectivity of the amygdala has been identified.[30]

THE HIPPOCAMPUS

The hippocampus is involved in regulating stress hormones through the HPA axis, fear learning, and memory.[31,32] Corticosteroid receptors are abundant in the hippocampus and evidence from rodent studies suggests increases in glucocorticoid levels, induced by chronic stress, inhibit new neuron formation and cell proliferation in the hippocampus.[31] In addition, smaller hippocampal volume has been identified in subjects with PTSD.[32] Older adults with significantly prolonged cortisol elevation were shown to have reduced hippocampal volume compared with normal cortisol controls and the degree of hippocampal atrophy correlated strongly with the degree of cortisol elevation.[33]

Evidence from both rodent and human studies identify pain-related changes in the hippocampus. Decreases in neurogenesis in the hippocampus in rodents subject to a neuropathic pain procedure were shown to be greater in a subset of animals also subject to a daily stressor.[34] Patients with chronic back pain have been shown to have smaller hippocampal volume and higher levels of cortisol than control subjects.[35,36] Fibromyalgia patients demonstrate reduced hippocampal volume compared with healthy controls.[37] In addition, hippocampal morphology and functional changes in people with migraine have been identified and related to headache frequency, accumulative number of migraines, anxiety, and depression scores and genetic variants.[38]

Together, these changes in cortical and subcortical activity associated with chronic stress and chronic pain suggest a relationship between the two conditions. While this relationship is merely correlational and not causative, it invites consideration of the role of chronic adverse stress and psychological distress in chronic pain and the potential application of stress reduction strategies to chronic pain treatment.

CLINICAL IMPLICATIONS

Based on evidence suggesting increases in adverse stress and psychological distress can be associated with increases in pain and disability, the question becomes whether treatment strategies that reduce stress could reduce pain and disability. Such strategies could include those that mitigate the experience of distress; fear and anxiety; and/or promote relaxation, positive mood, and self-efficacy. Although additional research is warranted, 3 lines of evidence show clinical promise:

1. Exercise: Physical activity and exercise as an intervention for patients with chronic pain has been shown to improve pain severity and physical function, and consequent quality of life.[40] Regular exercise has also been shown to prevent or ameliorate metabolic and psychological disturbances induced by chronic stress.[41] In addition, voluntary running has been found to enhance hippocampal neurogenesis in mice.[42] In older adults, aerobic exercise has been shown to increase the size of the hippocampus in comparison to control conditions.[43]

2. Mindfulness: Mindfulness training has been found to reduce pain in chronic pain conditions.[44,45] Mindfulness training has also been shown to decrease physiological markers of stress in a range of populations.[46] In addition, a systematic review of brain changes in stressed, anxious, and healthy adults who participated in mindfulness training identified increases in activity, connectivity, and volume in the PFC and hippocampus and decreases in activity in the amygdala.[47]
3. Social Support: In the laboratory setting, social support has been shown to attenuate physiological stress responses and experimental pain sensitivity.[48] In a study of older adults, medial PFC thickness was found to be positively correlated with social support while amygdala volume was negatively associated with social support and positively related to stress.[49]

Other therapeutic interventions that may be of benefit in reducing a patient's stress reaction include pain science education, breathing exercises, progressive muscle relaxation, guided imagery, and engagement in positive activities.[50–55] Further research is needed to examine the effects of these interventions on pain, stress measures, and corticolimbic activity.

SUMMARY

While chronic pain is a multifaceted and highly complex condition with no single cause or one-size-fits-all treatment, evidence suggests adverse stress and psychological distress may play a role in persistent pain and disability. In addition, chronic stress is associated with neuroplastic changes in the corticolimbic system, a brain region that also demonstrates changes in chronic pain conditions. An innovative theoretical model has been proposed that suggests maladaptive neuroplastic changes in the corticolimbic system associated with chronic stress may play a role in brain changes observed in chronic pain conditions. This would imply treatment strategies that contribute to a reduction in the stress reaction could potentially benefit patients with chronic pain. These treatment strategies include aerobic exercise, mindfulness training, and encouraging social activities that would enhance a patient's social support, as well as pain science education, breathing exercises, progressive muscle relaxation, guided imagery, and engagement in positive activities. This proposed theoretical model and the role of suggested treatment strategies on stress measures and corticolimbic activity warrant further research.

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EXPANSION OF PUBLISHED LITERATURE RELATED TO PHYSICAL THERAPISTS AND IMAGING

Several manuscripts are in development subsequent to research having been completed and still on-going relating to physical therapists and referral for imaging or the use of ultrasound imaging. By the time this *OPTP* appears in your mailbox, some may have been published and others are definitely forthcoming. One project we will be tackling in the future is a running reference list on the Imaging SIG webpage. The logistics of this are still being worked out, but we want a readily accessible list of references for those interested in this topic. Likewise, if you have just such a publication or a manuscript that has been accepted, please let us know so we can add it to the list.

REIMBURSEMENT

With referral for imaging privileges gradually expanding, we are incrementally achieving one of the primary objectives of the Imaging SIG. That success on the legal scope of practice front, however, does not guarantee our success in another critical area: reimbursement. With physical therapist use of both ultrasound imaging to complement clinical examinations and referral for other forms of imaging toward patient management, we are not guaranteed that reimbursement for those services for the patient by third-party payers will occur. There appears to be significant variability across locations and plans in whether reimbursement occurs or not.

The Imaging SIG will be forming a task force to address this. Clearly, this barrier must change for the expansion of imaging privileges to be successful. If you have an interest in this area and particularly if you have personal experience in this area, please contact us.

STRATEGIC PLAN

We continue to work in research, education, and practice in our strategic plan. This plan was formulated and initiated 3 years ago. In the coming months, we will be revisiting this plan for your input and for areas of particular emphasis that you see as important. Of course, we want your participation in this process, particularly if you have knowledge or experience in those related focus areas.

ULTRASOUND WEBINARS IN ASSOCIATION WITH AIUM

We are still looking for additional suggestions for physical therapist led webinars to be done with the American Institute for Ultrasound in Medicine. Over the past two years, they have sought our input into their educational programming. If you have suggestions for future webinars—both by topic and/or by presenter, please pass on your suggestions to us.

Remember that just two short years ago, AIUM did not recognize physical therapists in their training manuals and other official documents. Now, they ask us to help in their educational programming.

Those webinars remain available for free viewing by going through the website aium.org or by going to YouTube and finding AIUM's channel by simply searching for "AIUM webinar series." This is great continuing education at no cost.

LEGISLATIVE ACTIVITY

If there is an effort toward changing the scope of practice to include referral for imaging in your jurisdiction, please let us know. Word of these efforts sometimes travels slowly.

IMAGING SIG MEETINGS & COMMUNICATION

In addition to our live member meetings at Combined Sections Meeting, the Imaging SIG will conduct at least one web-based meeting in the year. These are usually announced 3 to 4 weeks in advance by email and through our social media outlets. If you are unable to attend those while being held real time, recordings of those meetings are available on our webpage on the Academy of Orthopaedic Physical Therapy's website.

Other forms of communication include occasional emails to all Imaging SIG members, our social media, and this publication. Please remember to save @orthopt.org among the safe domains in your email program.

IMAGING SIG WEBPAGE

Please remember to occasionally visit the Imaging SIG's webpage for information and resources. This is the direct link: https://www.orthopt.org/content/special-interest-groups/imaging

You can alternately find this by going to the Academy for Orthopaedic Physical Therapy's website and selecting from the "Special Interest Group" page.

Becoming a SIG member is not an additional cost beyond being a member of the Academy. You simply ask to be added as a member by selecting the "Become an I-SIG Member" item on the webpage.

Contacting the Imaging SIG officers, as suggested multiple times on this page, can be done through that page or by simply contacting the President at crhazl00@uky.edu (6th character is a lower case letter "L" followed by two zeros).

ORFSIG Members,

As 2018 comes to an end, it is important to reflect on the year and see what all we have accomplished.

Here is a recap of 2018!

STRATEGIC PLANNING

Thank you to Janet Bezner and our strategic planning members for your time in developing our new strategic plan. We look forward to implementing our Vision and Mission in 2019!

VISION:

To be a community of excellence in orthopaedic residency and fellowship education.

MISSION:

Serve and support the orthopaedic residency and fellowship community.

A special thank you to those members who have devoted their time and talent in the strategic planning process.

Board Liaison:
Aimee Klein
Practice Committee Chair:
Kathy Cieslak
Residency and Fellowship:
Molly Malloy
Academy Office Staff:
Tara Fredrickson
ORFSIG Leadership:
VP/Education Chair:
Kathleen Geist
Nominating Committee:
Chair: Matt Stark
Mary Derrick
Melissa Dreger

Members:
Chris Gaines
Chrysta Lloyd
Darren Calley
Megan Frazee
Kirk Bentzen
Kris Porter
Matthew Thomason
Mary Kate McDonnell
Sarah Nonaka
Stephen Kareha

ORFSIG STRUCTURE WITHIN THE ACADEMY OF ORTHOPAEDIC PHYSICAL THERAPY (AOPT)

Historically, residency and fellowship matters fell within the Practice Committee of AOPT. As we have developed there has been a question as to what matters would be the responsibility of the Practice Committee and that of the ORFSIG. After working with our Board Liaison Aimee Klein, and Practice Committee Chair, Kathy Cieslak we now have a better understanding of how responsibilities will be separated. Moving forward:

- ORFSIG will be primary contact and resource for Orthopaedic Residency and Fellowship related items.
- ORFSIG will work with Board Liaison for direction and communication to the Board.
- ORFSIG will provide recommendations to the ISC Editor regarding R/F curriculum package. Work in conjunction with Practice Committee.
- Practice Committee will continue to oversee R/F grant program (Academy funded grant).

NATIONAL STUDENT CONCLAVE

I had the pleasure of joining Rosie Canizares, VP of the Performing Arts SIG in attending National Student Conclave. We had several aspiring resident/fellows stop by the booth and say hello. The first 50 people received a free ORFSIG Shaker bottle, which was a huge hit! Thanks to Mary Derrick, Nominating Committee member, we were able to hand out a "Frequently Asked Questions" handout on why and how one should choose a residency or fellowship suited for them. It was great meeting with such young aspiring individuals.

The National Student Conclave also held the first ABPTRFE Residency and Fellowship Reception from previously being hosted at CSM. We will continue to investigate the options for programs to meet with prospective residents and fellows.

Manning the booth at National Student Conclave: Rosie Canizares, VP of the Performing Arts SIG and Matt Haberl, President of the ORFSIG.

"MENTORING THE MENTOR" WEBINAR

We co-hosted a free webinar regarding "Mentoring to Mentor." A HUGE thank you to Kris Porter, Arlene McCarthy, and Carol Jo Tischner for their tremendous work and time in presenting to a record number 72 attendees.

In 2019 we look forward to unveiling a new Annual Mentor Observation form to assist programs in taking their mentors from good to GREAT!

MEMBER SWAG

Mary Derrick and Matt Stark developed some great articles for our members to represent the ORFSIG. Make sure to come to the ORFSIG business meeting at CSM or swing by the

Academy of Orthopaedic Physical Therapy's booth to check out these great items.

ORFSIG Swag – come check it out at the Academy booth at CSM.

ABPTRFE RESIDENCY & FELLOWSHIP LEADERSHIP GROUP

Communication and collaboration have been a center focus in the continued development in residency and fellowship education. We are happy to be working with Kendra Harrington of the ABPTRFE along side the other Residency and Fellowship Leaders from the other Academies/Sections. In 2019 we look forward to building on the communication between ABPTRFE and programs. Here we have a community focused on collaboration in overcoming common barriers and building the future of residency and fellowship education.

COMBINED SECTIONS PRECONFERENCE EDUCATIONAL COURSE

Kirk Bentzen, Kathleen Geist, Aimee Klein, Tara Jo Manal, and Eric Robertson had their preconference course "Clinical Excellence and Quality Standards in Residency/Fellowship Education" accepted and presented on Wednesday, January 23rd at CSM. Thank you for helping our programs understand and implement the new quality standards.

If you would be interested in presenting at CSM 2020, please contact our VP, Kathleen Geist at kgeist@emory.edu

ABPTRFE AGGREGATE DATA OF RESIDENCY AND FELLOWSHIP PROGRAMS AND APPLICANTS REVIEW

The aggregate data regarding residency and fellowship programs and applicants was recently released. Within this release it was identified that there was a surplus in residency and fellowship positions. To better understand this data, the ORFSIG established a work group lead by Peter McMenamin, Tom Denninger, Kevin Farrell, Joe Donnelly, and Stephan Kareha to evaluate low resident application volumes and potential reporting measures that may affect the data.

Several questions remain regarding the current aggregate data where we hope to gain clarity:

- Are there regional shortages/surpluses?
- Does model matter? Are current prospects choosing a specific model (Hospital, University, Private Practice, Hybrid, etc.) / specific models suffering?
- Is the demographic of residents/fellows changing?
- Is our production of residency/fellowships in line with our market prospective res/fellows?

STANDARDIZED OFFER DATE PROGRAM SURVEY

Given some of the struggles from programs filling residency positions and feedback from clinical sites regarding multiple resident interviews in their final internship, the question of a standard offer date was proposed. To better understand this Stephan Kareha, Misha Bradford, Aaron Keil, and Eric Magrum sent out a survey to all orthopaedic residency and fellowship directors. Seventy nine programs responded to date with the majority of programs (54%) not interested in a common offer date. A more detailed breakdown of the survey will be found in our next edition of *OPTP* magazine.

Given the low response, further discussion included looking at the possibility of sharing a list of programs who may still have openings to prospective residents/fellows who do not get accepted. This will be a discussion topic for 2019.

PROGRAM DIRECTOR PAYMENT AND SALARY STRUCTURES

A work group has been developed to understand current Program Director salaries/benefits to assist program directors in discussions with administration regarding time allotment for ongoing management, mentorship, accreditation, etc. More to come on this in 2019!

ABPTRFE COMMUNICATION AND QUALITY STANDARDS

As many of you already know, the implementation of the new Quality Standards will come into effect January 2020. Recently, the new Process and Procedures Manual and Crosswalk document as well as expectations for Annual Continuous Improvement Reporting (formally Annual Report) exhibits 2-4 were released. Several questions and concerns remain regarding the tracking and submission of the 57 Primary Health Conditions. The ORFSIG will continue to work with ABPTRFE in communicating any developments and timelines for implementation. We encourage all programs to still contact ABPTRFE in addition to the ORFSIG with any specific questions or concerns as well as sign up for updates on the APTA HUB.

OPTP QUARTERLY SUBMISSIONS

The ORFSIG will continue to accept case reports, resident/fellowship research, etc. to be highlighted in future issues of *OPTP.* Take this opportunity to highlight your programs participants work!

Thank you to all our members for their hard work.
Matt Haberl,
President, ORFSIG

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT, CERP

Combined Sections Meeting, 2019 - Washington DC

Another great year has been planned for the APTA Combined Sections Meeting in Washington, DC, January 23-26, 2019. The ARSIG Business Meeting will be held from 7:00 a.m.-7:50 a.m. on Friday, January 25th followed immediately by the two-hour programming session starting at 8:00 a.m. The ARSIG Educational Session for CSM is entitled, *"Manual Therapy For Equine And Canine Clients: Different Species, Same Concepts,"* Presenters: Kirk Peck PT, PhD, CSCS, CCRT, CERP; Sharon Classen PT, ATC, CERP; and Karen Atlas PT, MPT, CCRT. I sincerely hope to see you present in the wonderful District of Columbia come January.

ARSIG Membership

As of November 10, 2018, the ARSIG website indicated a membership total of 444 licensed therapists. The SIG has continually grown in numbers over the past several years. This is an excellent sign for long-term sustainability, but my fingers remain crossed that someday a magic number of 1,000 members will appear on the big screen upon hitting "search" in the web-directory.

Six Years Equates to 2190 Days!

Some might claim it was the best thing I ever did. Others might disagree. Either way, now that my term in office is over as ARSIG President, I can honestly say I would, without question, do it all over again if granted the chance. It has truly been an honor serving as an officer in an organization that I hold great passion for on many levels. I firmly believe that the future of physical therapy involvement with animal rehabilitation and fitness performance looks bright, especially upon witnessing the next generation of graduates expressing strong interest in expanding career practice options to include non-human clients.

It has now been 40 years since Ann Downer, BA, MA, LPT, published the 1st textbook (1978) in the United States on physical therapy for animals. The book was entitled, *"Physical Therapy for Animals: Selected Techniques,"* and of interest, the first comment in a book review of Downer's work stated, *"The need for a text which provides an introduction to the principles and techniques of physical therapy in veterinary medicine is significant."* [1(preface)] It is amazing how true that statement was in the late 1970s, and yet remains just as relevant today. Although several excellent text references have been published by various physical therapists over the past 10 to 15 years, an incredible void remains in the voluminous amount of knowledge yet to be shared in the practice of animal rehabilitation.

A Future Worth Dreaming - A Vision Worth Seeking

According to Merriam-Webster, the word "vision" may be defined various ways, but the one I believe applies most to evolving professional organizations is, *"The act or power of imagination; Unusual discernment or foresight."*[2] In essence, vision is not just words crafted on paper to please a board of directors, shareholders, or employees, but rather it is clarity in expression of thought and understanding that stems from a source of inspiration extending beyond the tangible.

Successful leaders have vision, or at least an ability to surround themselves with those who are capable of exceptional forecasting. It is my personal hope that in passing the torch of leadership to the next generation of elected ARSIG officers that a macroscopic vision for the future of the organization will continue on an evolutionary path that will ultimately integrate the competencies of animal physical therapy as an accepted component of practice within the profession on a national scale. Such a grand vision can be fully accomplished however only if the following conditions prevail: (1) Statutory laws and regulations in all 50 states must legally recognize physical therapy practice on animals; and (2) Accredited programs in higher education must be developed to support the practice of physical therapy on animals based on formally recognized standards, similar to the current competencies adopted by the Commission on Accreditation in Physical Therapy Education. Elaborating on the second condition, a vision for creating a formalized educational program for animal physical therapy was actually articulated 40 years ago.

In the preface of her text published in 1978 on physical therapy for animals Ms. Downer stated, *"The concept of total physical therapy for animals is not new, but the practice of it by a qualified physical therapist under a veterinarian is new. Still to come are college programs designed especially for training student to become animal physical therapists."* [1(pV)] So I challenge you, and all future great leaders who join the field of animal physical therapy…I ask that you not only believe in but also fully embrace a dream that a day will come when physical therapists are publically recognized as expert health care practitioners in treating not only humans, but animal companions as well. The time has come to see Ms. Downer's vision come to light.

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1. Downer A. Physical Therapy for Animals. Selected Techniques. *Can Vet J*. 1978;19(11):303.
2. Vision. Merriam-Webster website https://www.merriam-webster.com/dictionary/vision. Accessed November 9, 2018.

Contributory Acknowledgment

In this edition of *OPTP*, Jenny Jones, PT, MS, DPT, CCRT, submitted an educational case study on the topic of osteoarthritis in a 10-year-old Cattle Dog. It depicts the challenges and rewards of implementing a thorough plan of care in rehabbing a dog well deserving of expanding quality in life through improved physical ability. I congratulate Jenny on her contribution of sharing a snippet of wisdom and passion for treating the canine species.

"I was informed by authorities that my mother was a large Black Bear, but apparently my DNA test indicated otherwise. I'm just a little Chorkie."

Scout & Luna – Truly the Best of Friends!

Photo Courtesy of Kirk Peck

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Physical Rehabilitation in Severe Osteoarthritis: A Case Study

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Osteoarthritis (OA) can be a challenging condition to manage in the canine population. Conservative management of OA in veterinary medicine is often centered on pain management with nutraceuticals, nonsteroidal anti-inflammatory agents, and pain medications. It is now becoming more commonplace to take a multimodal approach, with the addition of physical rehabilitation along with acupuncture and laser therapy. Physical therapists can help patients regulate pain, improve muscle mass for joint protection, and maximize functional ability.

HISTORY

Rangler is an approximately 10-year-old neutered male Australian Cattle Dog who was adopted in May 2017. Rangler was found as a stray in a field, so his past medical history is unknown. Rangler was found to have severe OA in the left elbow as well as OA in the coxofemoral joints. Rangler was intact when found, then neutered when a nerve sheath tumor was surgically excised from the right hind limb. Rangler underwent electrochemotherapy at the onset of physical rehabilitation. The recommendations from the orthopedic surgeon included physical rehabilitation. Rangler began with acupuncture in June 2017 while waiting to begin physical rehabilitation in early July 2017.

Medications at time of evaluation (7/3/17): salmon oil, gabapentin 300 mg TID, Dasuquin SID, tramadol PRN, Galliprant 30 mg SID.

Environmental concerns: Rangler lives in a two-story home with tile floors, which causes issues with slipping. There are two other dogs in the home and Rangler also goes to doggy daycare. He is able to jump on/off furniture.

Subjective pain scores: 3/10 overall, 4/10 during activity, 6/10 after activity. Scores are based on client's observations of increase in lameness with and especially after activity.

Client goals: For Rangler to be pain free, happy, and active.

Physical Examination (7/3/17):

Body Condition Score = 5/9

Weight = 50.0 lbs

Orientation: BAR, friendly and affectionate, but history of mouthiness with past exams.

Other physical findings: Harness donned.

Posture: Showing internal rotation in right pelvic limb (RPL). Stands with RPL in mildly odd positions. Tail posture WNL. Able to sit squarely; when standing, shows only partial to non-weight bearing stance in left thoracic limb (LTL). Prefers to lie sternal with L carpus flexed.

Transitions: Independent with fair to good use of LTL.

Gait analysis: Stilted PL gait R>L, grade 2 LTL lameness with head bob.

Musculoskeletal exam:

Limb girth: TL L 32 cm, R 36 cm. Proximal thigh 43 cm bilaterally. Proximal calf L 21.5 cm, R 21 cm.

Palpation: Peripheral joints all WNL and non-effusive except left elbow severely thickened and mild-moderately painful. Right hip guarded at end range extension, improved with massage. Psoas comfortable bilaterally.

TL ROM: WNL except left elbow 90 degrees flexion with early hard end feel, 160 degrees extension with early hard end feel.

PL ROM: WNL

Spinal mobility: Moderately hypomobile with dorso-ventral (D/V) pressures in thoracolumbar spine, but no pain. Tail jack negative, cervical spine WNL.

Neurological exam:

Reflexes: LPL- 3+ patellar, 2+ sciatic/cranial tibialis. RPL- 1+ patellar, sciatic, cranial tibialis.

CP placing: TLs WNL, PLs intact and brisk, but placing wide bilaterally

Withdrawals: Present x 4

Hopping: Mildly delayed in PLs

Pain sensation: Present, not formally tested

Bowel/bladder function: Normal

Assessment (7/3/17):

Rangler ("Rango") is an approximately 10-year-old NM Australian Cattle Dog who has a referring diagnosis of elbow arthrosis and hip pain. Rangler presents to physical rehabilitation with moderate atrophy of the left thoracic limb with moderate-severe left elbow restrictions, mild right distal hind limb atrophy, mild neurological deficits in the pelvic limbs, hypomobility in the thoracolumbar spine, and right hip pain. Rangler will benefit from physical rehabilitation to work toward improved strength and comfort of the left thoracic limb, improved spinal mobility and pelvic limb function, and overall improved exercise tolerance.

Goals (8 weeks):

1. Will demonstrate a 1/4 or better lameness score in LTL.
2. Will tolerate a day of daycare without an increase in LTL lameness.
3. Will have an increase in left thoracic limb muscle mass by 2 cm to demonstrate improved strength.

Plan (7/3/17):

Rangler will participate in physical rehabilitation once per week for 4 to 6 weeks, then potentially ongoing at some frequency to improve strength and mobility. Rangler's sessions will include manual therapy (myofascial release, joint mobilizations, stretching, soft tissue massage), modalities as needed, therapeutic exercise, balance and proprioception training, and gait training in the underwater treadmill. A home program will begin to help Rangler improve strength and ensure smooth progress towards his goals. At home pulsed electromagnetic field therapy would be of significant benefit to Rangler, either with an Assisi Loop or the Respond Systems Bio Pulse bed.

A home program was prescribed following review, including text and photos for triceps and biceps stretches, tail traction, high stepping, walking backwards, push-ups, and crawling under.

PSGAG injections were started (using generic ICHON) with rehabilitation sessions, following the loading dose weekly and maintenance monthly injections.

Treatment:

Therapeutic exercise:

Rangler has been attending physical rehabilitation sessions weekly since his evaluation in July 2017. His sessions initially did not include the underwater treadmill, as he was significantly fearful of the treadmill. We were able to quickly condition him to using the land treadmill and incorporated many dynamic balance exercises using both the land treadmill, physiorolls, and other equipment such as Cavaletti rails, memory foam mats, and balance discs (Figure 1 and 2). Rangler's sessions also include manual therapy to improve mobility and flexibility of the spine and extremities. The underwater treadmill was successfully added in February 2018 to reduce stress through the extremities and provide resistance for strengthening. Water wings are added to provide additional resistance to the LTL.

Manual therapy:

Myofascial release, including lumbosacral decompression with tail pulls, cross-hand releases to thoracic and lumbar spine. Transverse plane releases at pelvic floor, respiratory diaphragm, and thoracic inlet. Compression through left elbow into shoulder followed by leg pull. Occasional rotational mobilizations to thoracolumbar spine, grade 3.

Modalities:

LASER - Respond Systems Luminex Vet, class 3b.

- 808nm 1000mW (1W) continuous wave probe
- 10 Joules/cm^2 to left elbow and bilateral coxofemoral joints
- 4 Joules/cm^2 to each segment of thoracolumbar spine per side, caudal to scapulae to sacrum

Clinical Progress:

- Minimal to no LTL lameness by the end of August 2017, approximately 8 weeks into rehabilitation.
- Able to complete a day of daycare without increase in lameness by end of August 2017.
- Improved left elbow range of motion comfortable without crepitus, 80° flexion with early hard end feel and 165° extension with early hard end feel. Girth measurements showed mild improvement (2 cm) in RTL.
- Current medications (5/29/18): ICHON injections monthly, Dasuquin, Galliprant, salmon oil, amantadine.

Clinical update 5/29/18:

Rangler continues with physical rehabilitation weekly to build and maintain strength in his limbs, as well as work on core strength to protect his spine. Rangler's mild proprioceptive deficits and mild hyperesthesia suggest that he may have some mild compressive disease process in his spine, but an MRI is not indicated at this time given his high level of function and comfort. He discontinued acupuncture at the end of July 2017 to focus on physical rehabilitation. Rangler is able to walk from his home all the way to the clinic and back, 1 mile each way, in addition to going to daycare and playing with housemates, all without lameness. Rangler thoroughly enjoys his rehabilitation sessions and has made huge strides in not only his physical strength and coordination, but his confidence and fear behaviors as well. He has a wonderful quality of life, and is maintaining his owner's goals of being happy, pain-free and active.

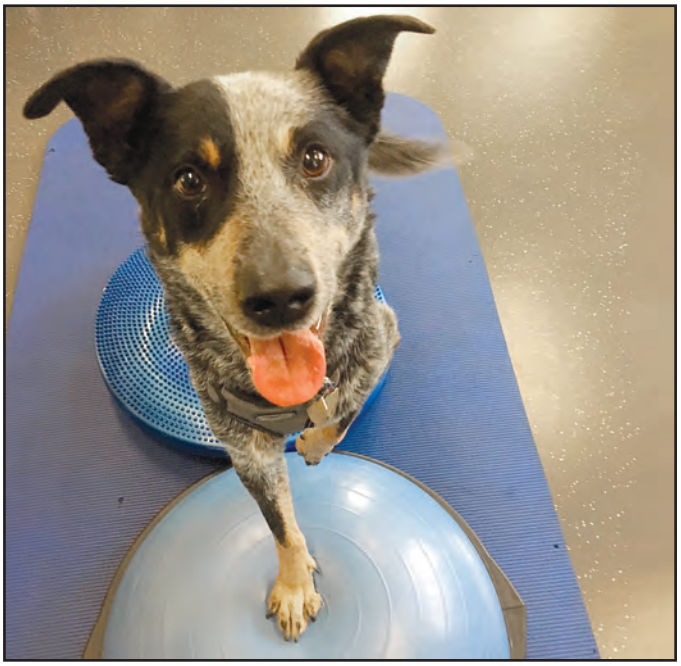

Figure 1. Bosu ball. Rangler developing balance and proprioception on a Bosu ball.

Figure 2. Cavaletti Rails. Rangler navigating Cavaletti rails for range of motion and strength.

(Note: Since writing this article, Jenny has opened her own canine rehabilitation center, Pawesome PT, in Stateline, NV).

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