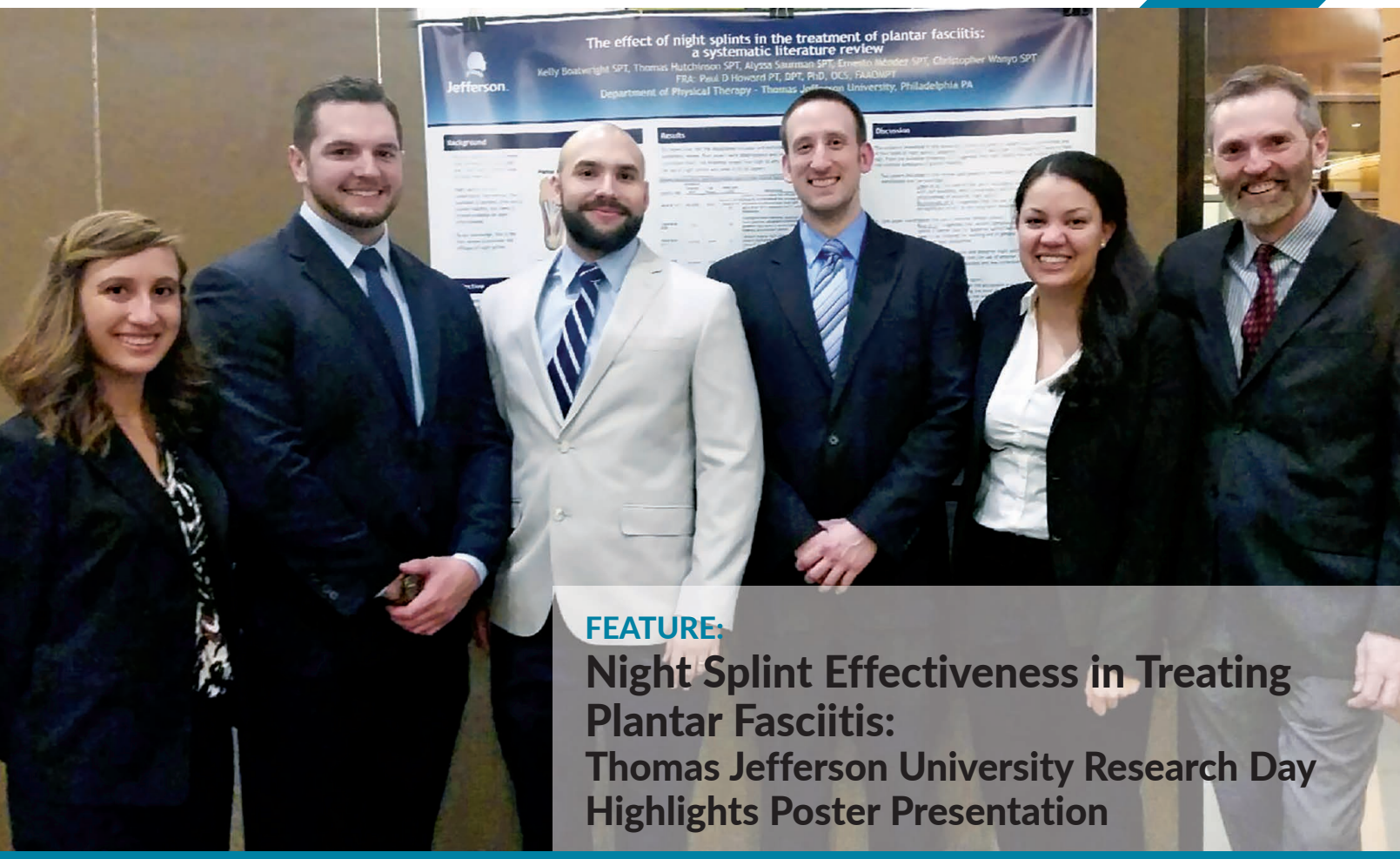
2017 / volume 29 / number 4

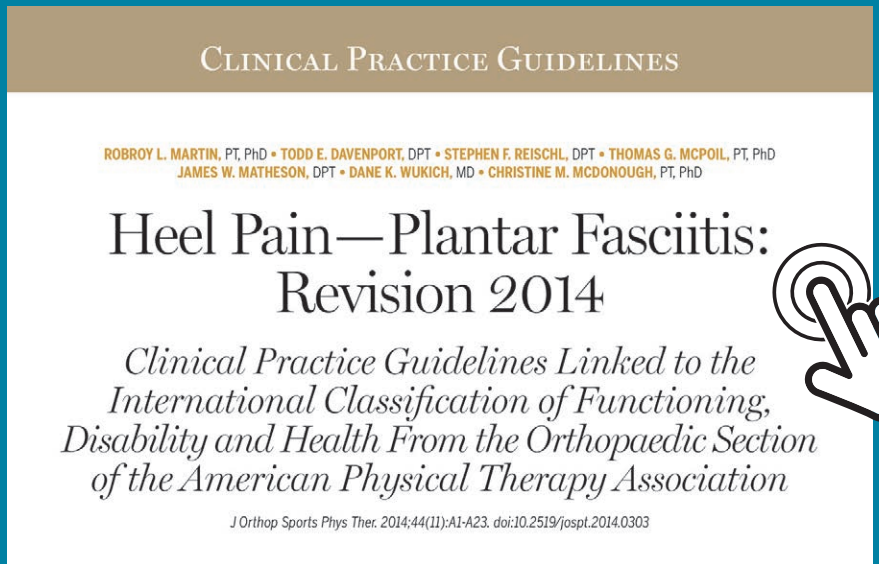
ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The magazine of the Orthopaedic Section, APTA



FEATURE:

Night Splint Effectiveness in Treating Plantar Fasciitis:
Thomas Jefferson University Research Day Highlights Poster Presentation



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ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The magazine of the Orthopaedic Section, APTA

In this issue

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Editor's Note

Are We Who We Think We Are?

Christopher Hughes, PT, PhD, OCS, CSCS

They say perception is reality. Given the recent changes in health care and the ongoing turbulence ahead, now is as good of a time as any to maybe do a reality check on where we have been and where we are going as a professional and as a profession.

I think it is a really crazy time for everyone, regardless of the setting you work in. Just put aside the whole wild wild west of social media. Take academia, we have sweeping propositions under debate such as with the 2017 House of Delegates RC 13-14: BEST PRACTICE FOR PHYSICAL THERAPIST CLINICAL EDUCATION document that attempts to take on the challenge of what to do about clinical education. As many of you know, we have major challenges in this area from anywhere you sit… Student, ACCE, or CI. From that document, the goal is: "to identify areas of collaboration and different strategies to achieve the common goal of excellence in clinical education. If other recommendations are adopted, successful implementation will only occur with full participation and collaboration among all relevant parties." One suggestion caught my eye. This was the suggestion/proposition of a national clinical education matching program for assigning students to clinical education sites. My first thought was, "what does that selection algorithm look like and who do I lobby for a preferential seat at that table?!" Let's go to traditional hospital-based care. I am having a hard time keeping up with who has merged with who, and who owns who. Or, what electronic documentation system are we using today? Is there such a thing as traditional outpatient care? Are we self-pay, hybrid, or a wellness center? In the area of research, where is the money this year? What funding agency was cut or abolished this year? Translational research centers aside, how do we get the information to the ground troops who have to be on the front line? Has the gap between research and practice gotten narrower or wider? Go visit 5 different clinics and inquire about treatment plans for the same diagnosis and then let me know what you think.

Let's turn to Vision 2020 (http://www.apta.org/Vision2020/), which was developed in 2000. I remember when the vision first came out, 2020 seemed so far away. Hard to believe it is just around the corner. The anchors of that crafted vision were admirable; Autonomous Physical Therapist Practice, Direct Access, Doctor of Physical Therapy and Lifelong Education, Evidence-based Practice, Practitioner of Choice, Professionalism. The terms are all very relevant but it did not take long, about halfway through the timeline, for our leaders to decide to revise/reflect an initiative at the 2011 House of Delegates (House) to bring forth a revised Vision to the House of Delegates no later than 2013. http://www.apta.org/BeyondVision2020/ http://www.apta.org/VisionStrategicPlan/

The new and improved vision statement? "Transforming society by optimizing movement to improve the human experience." This revision now advocates new principles of Identity, Quality, Collaboration, Value, Innovation, Consumer-centricity, Access/Equity, and Advocacy. Wow! I went back to re-read the accompanying text of each principle. Add to the equation the concept of movement systems and we have our hands full! I then thought about some statements my patients have made in the clinic:

- ✓ "I didn't know PTs do that."
- ✓ "Do you guys do acupuncture?"
- ✓ "Can you come to my house so I don't have to drive to the clinic?"
- ✓ "My personal trainer says…"
- ✓ "I can't pay this co-pay."
- ✓ "Honestly I never have time to do my exercises, but when can I play golf?"
- ✓ "Do you guys do cupping?"
- ✓ "Where do I buy that cool looking tape I saw on the pros?"
- ✓ "My doctor said…(you fill in the blank with anything you want here and it would probably be enlightening!)
- ✓ "I read this on the internet and the expert said…"
- ✓ "I see a chiropractor twice a week to stay aligned."
- ✓ "Why do some PTs call themselves doctors?"

Given these questions and statements, in the eyes of our patients, are we who we think we are? Is it clear to the customer?

I found it intriguing when my ISC Associate Editor, Gordon Riddle, PT, DPT, ATC, OCS, SCS, CSCS, guest lectured for me and he started the lecture off with a question to the class, "what do PTs do?" There was dead silence from the first year class. Oh given a little prodding they started to remember, but for starters, they had to think hard about how to answer as concisely as you should with the elevator speech scenario (ie, a brief message that communicates what you are all about in a short time or the time it takes people to ride from the top to the bottom of a building in an elevator). Not shocking that it was hard since we have a varied skill set and we are in so many settings, but shouldn't we be able to define ourselves and then make sure that definition is clear to our patients?

I have always felt the underpinning of a strong profession is the lowest common denominator. In physical therapy that would be the practice or care that a consumer/client is exposed to that provides the lowest form of care but yet still meets the minimum standard. In this regard I am not sure we have consolidated our lowest common denominator to a level we would call "standard of care." I think we can all relate to the patient who comes to us and is amazed that the previous therapy experience at another facility in no way, shape, or form is mimicked (good or bad) in what he or she is experiencing currently.

Personally, my experience has been that patients are more confused than ever as to what PTs do and how they do it. Maybe this is a sign that we have branched out and accentuated certain skills (dry needling, sports performance, women's health, animal PT, etc) but sooner or later one has to go back and try to define from a practical perspective, what is it that we do and are we who we think we are? Forgive me as I flash back to the company-wide memo Tom Cruise sent in the movie, *Jerry Maguire* when he writes his conscience and it promptly gets him fired. What do you think?

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2018 CSM Preconference Courses

Visit www.apta.org/CSM/Programming/ for full details on each of these preconferences and to register!

Tuesday & Wednesday, February 20–21, 2018
8:00AM–5:00PM
Keep Calm and Treat Pain- From Research to Clinical Practice
Sponsored by the Pain Management Special Interest Group (PMSIG), Orthopaedic Section, APTA

Description: Physical therapists are key to achieving the National Pain Strategy's goal to reduce the burden and prevalence of pain and to improve the treatment of pain. This 2-day pre-conference course will provide you with the latest pain science and evidence-based evaluation and treatment skills you need to successfully treat patients in pain and help meet this national goal. Experts in pain science, pharmacology, psychology, sleep, nutrition, motivational interviewing, mindfulness and mindful movement will share their knowledge and skills. You will have a chance to practice pain evaluation, education and treatment techniques. The role of telerehabilitation to address the needs of patients unable to access physical therapy in person will be included. Case presentations will provide you with clinical reasoning insights and understanding. Join your colleagues for what will surely be an exciting, engaging and dynamic 2 days of learning!

Trust in Your Thrust! Implementing High Velocity Techniques into Your Practice
Wednesday, February 21, 2018
8:00AM–5:00PM
Sponsored by the Orthopaedic Residency/Fellowship Special Interest Group (ORF-SIG), Orthopaedic Section, APTA

Description: Common barriers to the use of High Velocity Low Amplitude (HVLA) techniques often cited by students and clinical instructors include lack of confidence and insufficient instruction. These lead to underutilization of spinal and peripheral HVLA techniques in the clinic. These barriers remain despite the 2006 CAPTE mandate to include HVLA instruction in entry level PT education programs. Wide variation remains in methods and quantity of instruction across PT programs in the U.S. This course will address specific barriers to implementation of HVLA techniques in the clinic, including: safety, therapist confidence, and patient selection. Both spinal and peripheral HVLA techniques are included with a priority placed on patient comfort and minimal leverage and force used. A framework for implementing HVLA techniques into clinical practice will be presented based on current best evidence. There will be an emphasis on clinical reasoning and examination findings that assist with technique and patient selection. Reassessment of examination findings after technique application will be used to assess treatment outcome. The course will primarily consist of lab sessions with interspersed instructional components. We will discuss indications/contraindications of HVLA, screening for cervical artery dissection (CAD), and concepts related to this model of spinal positioning and locking for HVLA. Specific techniques and strategies from osteopathic and Australian traditions will be presented. The focus of this course will include primary 1:1 skills instruction so that participants can confidently implement these techniques into their practice.

Achieving Clinical Correlates: Imaging Implications for Physical Therapists
Wednesday, February 21, 2018
8:00AM–5:00PM
Sponsored by the Imaging Special Interest Group (I-SIG), Orthopaedic Section, APTA

Description: This one-day course will consist of imaging for physical therapists with clinical and educational perspectives. It will cover imaging within a primary contact context, including developing an enhanced ability to undertake proficient screening within the accepted triage model along with better understanding the patho-anatomy associated with many of the health conditions in patients for which physical therapists routinely provide clinical management. Rather than diminishing the importance of the patient-clinician interaction at the time of initial presentation, participants will recognize how diagnostic imaging emphasizes the need for a precisely completed clinical examination. The most commonly used imaging modalities, predominantly for musculoskeletal disorders, will be described for their capabilities and limitations in detecting particular patho-anatomical changes due to trauma, disease processes, or other origins. Radiography, CT, MRI, ultrasound, and DXA are included along with their clinical applications toward decision making. A regional approach will be undertaken with descriptions of common musculoskeletal pathologies, including their clinical presentations and the need or lack thereof for imaging. Common anatomical variants and developmental changes over the lifespan are offered in context with those pathologies. Use of imaging guidelines are featured along with the underlying clinical reasoning for their use. Resources for continued learning are also provided.

The Effect of Night Splints in the Treatment of Plantar Fasciitis: A Systematic Literature Review

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ABSTRACT

Study Design: Systematic literature review. **Purpose:** To determine the effectiveness of night splints for the treatment of plantar fasciitis. **Background:** Plantar fasciitis occurs in more than 2 million Americans each year and is the most common cause of acute heel pain. Conservative and nonconservative intervention options exist in the literature, but there is limited evidence on the effectiveness of night splints. Night splints are one conservative intervention that is available to patients affected by plantar fasciitis, and to our knowledge, this is the first review to evaluate their effectiveness. **Methods:** Searches of electronic databases (CINAHL, PubMED, Cochrane, PEDro, Scopus, Sports Discus, and Ovid-Medline) were conducted for research studies from June 2005 to June 2015. The GRADE approach was used to evaluate the quality of each paper. **Results:** Six papers that met the established inclusion and exclusion criteria were included in this systematic review. Four papers were observational and 2 papers were randomized controlled trials. The evidence ranged from high to very low quality. Recommendations for the use of night splints were weak for use in all 6 papers. **Conclusions:** The available evidence suggests night splints may be helpful in treating the common symptoms of plantar fasciitis, with anterior splints being better tolerated than posterior splints.

Key Words: heel pain, running injuries, intervention

INTRODUCTION

Plantar fasciitis affects more than 2 million Americans each year[1,2] and is responsible for more than 600,000 outpatient physical therapy visits annually in the United States.[3,4] Plantar fasciitis has been reported to account for approximately 10% of injuries that occur in association with running,[5-7] as well as occupations that require prolonged periods of standing and walking.[6,8,9] The incidence of plantar fasciitis peaks between the ages of 40 and 60 years[5] with a higher incidence in women.[9] Other risk factors include greater body mass index,[8-11] presence of heel spurs, faulty foot mechanics (supinated and pronated foot), abnormal walking pattern, lower limb-length discrepancy,[12] limited ankle dorsiflexion,[7,9,10,13] work-related weight-bearing activities, and improper shoe support.[13]

The plantar fascia is a tight band of connective tissue that connects the heel bone to the toes and acts like a biomechanical shock absorber supporting the arch of the foot.[13,14] Plantar fasciitis is the most common cause of inferior heel pain.[15] It is a condition in which repetitive and excessive loading tension causes micro-tearing, inflammation, and painful sharp/stabbing sensation of the plantar fascia.[13,16-18] This disorder is often characterized by stiffness and progressive pain with weight bearing, especially with the first steps upon awakening.[19] Pain normally decreases with sustained standing and walking activities due to stretching of the fascia. However, the symptoms typically return later in the day after long periods of standing or walking due to excessive loading and stress on the plantar fascia.[20] Plantar fasciitis pain also typically returns with the first steps after prolonged sitting as the plantar tissue is reloaded.[21]

Studies show approximately 90% of plantar fasciitis cases are self-limiting and will improve within 6 months with conservative treatment leaving about 10% of patients continuing with plantar fasciitis long term.[22] In a long-term follow-up study by Wolgin et al,[23] it was observed 80% of patients treated conservatively for plantar fasciitis with stretching, shoe inserts/change, night splints, nonsteroidal anti-inflammatory drugs (NSAIDs), injection, and rest had complete resolution of pain at 4 years.[3] The management of plantar fasciitis can be classified into conservative and surgical approaches. The most common conservative interventions include low dye strapping, orthotic insoles, pharmacotherapy, dorsiflexion night splints, stretching programs for Achilles tendon and plantar fascia, and extracorporeal shock wave therapy.[24-27] Surgical interventions include procedures such as plantar fasciotomy and plantar fascia release.[24] The American College of Foot and Ankle Surgeons Heel Pain Committee recommends patients should have chronic symptoms and undergo conservative treatment for at least 6 months prior to considering surgical options.[24]

Night splints are commonly used in the management of plantar fasciitis. The goal of night splint therapy is to maintain dorsiflexion of the ankle and also the toes in certain splints, resulting in a constant, consistent stretch on the Achilles tendon and plantar fascia.[28] By placing the tissues under consistent strain, the fascia remains lengthened and allows healing to occur with tissue close to functional length.[29] Stretching of tight soft tissues is explained by the physical property of creep, the plastic deformation in response to strain.[29,30] For the purposes of this systematic review, our research focused on the use of night splints for the treatment of plantar fasciitis and the current evidence regarding their ability to affect symptoms associated with plantar fasciitis.

METHODS

Search Strategy

A search of the literature was performed in July 2015 using the CINAHL, PubMED, Cochrane, PEDro, Scopus, Sports Discus, and Ovid (Medline) databases. The PICO model (population, intervention, comparison, and outcome) was used as a search strategy to identify relevant studies. The population search term was plantar fasciitis while the intervention search terms were physical therapy and night splints. No search terms were used for comparison group or outcome. All three search terms were combined with 'AND.' The citations from the search were stored and organized using RefWorks.[31]

Selection Criteria

The citations were selected based on the inclusion and exclusion criteria. Clinical cases published in English between June 2005 and June 2015 that used night splints as a form of treatment for patients 18 years or older with a diagnosis of plantar fasciitis were included. Citations were excluded if patients had previous surgery of the involved lower extremity.

The initial search of the 7 databases yielded a total of 99 papers. After duplicates were removed, 55 papers remained. These remain-

ing papers were evaluated based on the titles, abstracts, and inclusion/exclusion criteria. Following this evaluation, one paper remained that studied the effectiveness of night splints as an intervention for the treatment of plantar fasciitis. Throughout the evaluation of the 55 papers, 5 additional papers were found through hand-searching their reference sections. This left a total of 6 papers for review and discussion. The results of the literature search are displayed in Figure 1.

Article Assessment

Six reviewers examined and evaluated the 6 papers selected from the search of the literature. Each paper evaluation was discussed among the entire group. Group members rotated the position of leading the respective paper discussions. Group discussions and grading of the 6 papers were guided by the GRADE approach (grading of recommendations, assessment, development, and evaluation).[32-34] Following discussion of each paper the grading was achieved by group consensus.

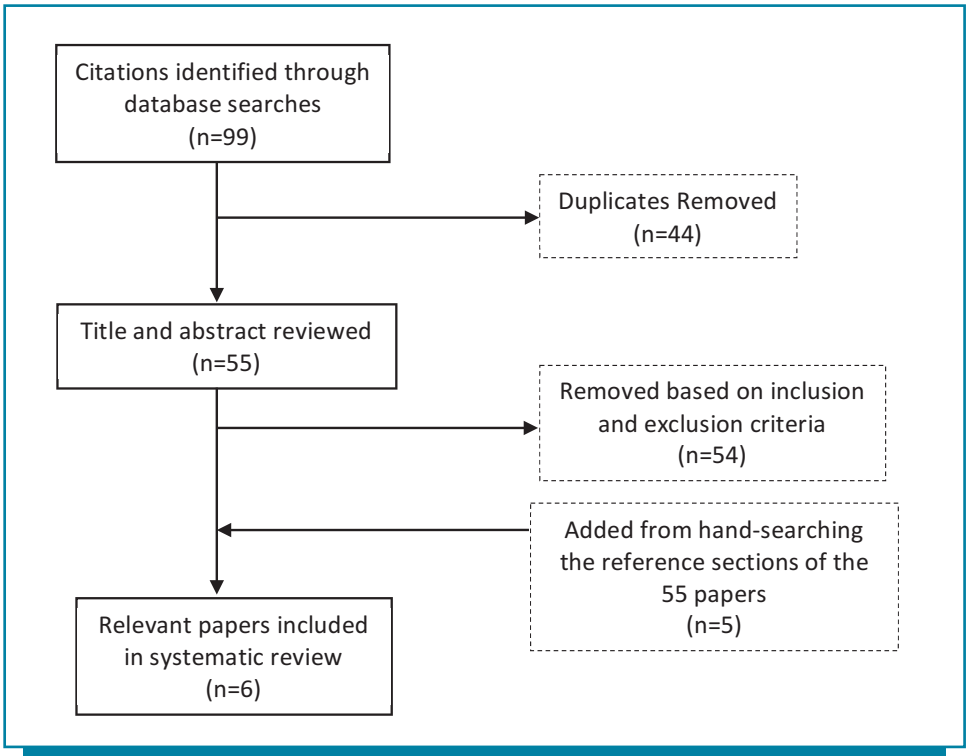

Figure 1. Flow diagram for paper identification, review, and selection.

RESULTS

The 6 selected papers included 2 randomized controlled trials (RCTs) and 4 observational studies. The evidence supporting the interventions ranged from high to very low quality. Recommendations for the use of night splints in the treatment of plantar fasciitis were weak for use across all included papers. Individual grades and a summary of findings are in Table 1. Reviewers were in agreement when grading all 6 papers. Patient characteristics and interventions used are presented in Table 2. The length of the interventions ranged between 8 weeks and 33.2 months. Two papers had follow-ups occurring at 12 weeks and 2 years.[35,36] Outcome measurements used included Foot Functional Index (FFI) questionnaire, Visual Analog Scale (VAS), Modified Ashworth Scale, Observational Gait Scale, Numeric Pain Rating Scale, Foot and Ankle Outcome Score (FAOS), daily logs for compliancy, Plantar Fasciopathy Pain/Disability Scale, and Ankle-Hindfoot Rating Scale (AHRS). Interventions used in the papers included: custom-fitted orthosis, posterior dorsiflexion night splints, anterior dorsiflexion night splints, autologous blood injections, botulinum injections, NSAIDs, corticosteroid injections, silicone heel cushion for shoes, silicone heel cushion for slippers, stretching exercises, activity modification, and diet.

Posterior Night Splints

Two papers examined the effectiveness of posterior night splints for the reduction of pain directly associated with plantar fasciitis.[36,37] Logan et al[37] examined an intervention including an adjustable posterior night splint to maintain neutral ankle position, autologous blood injections, and botulinum toxin A injections for the treatment of plantar fasciitis accompanied by spasticity. A patient with left plantar fasciitis was treated with standard physical therapy including ultrasound, iontophoresis, ice, heat, stretching, night splints, steroid injections, anti-inflammatory medications, and shoe orthotics. None of these treatments provided relief for more than 2 days and the patient reported pain of 8/10 on the VAS. Two weeks after the botulinum toxin A injections, the patient reported pain of 2/10 on the VAS at the base of the calcaneus and felt well enough to return to school. Pain was completely resolved by one month post-injection and the patient continued without pain for at least 12 months after treatment. Beyzadeoglu et al[36] evaluated the effectiveness of adding a dorsiflexion night splint to the conservative treatment of plantar fasciitis. Although no significant differences were observed on the initial AOFAS and VAS scores between the 2 intervention groups, patients using a night splint exhibited significant improvement in both scores at the 2-month follow-up. In addition, the physical complaints of the group wearing the night splint decreased by 79% using a VAS, compared to 62% for those who did not wear the night splints.

Anterior Night Splints

Two papers examined the effects of anterior night splints to reduce symptoms associated with plantar fasciitis.[35,38] Attard and Singh[38] evaluated and compared the comfort, compliance, and effectiveness of a posterior ankle foot orthosis (AFO) (which dorsiflexed the ankle) with an anterior AFO (which maintained the ankle in plantigrade). They reported that 67% of all patients had reduced morning pain and stiffness after wearing either AFO for 6 weeks. In the group who improved, 76% of the patients wore anterior AFOs and 56% wore posterior AFOs. Of the patients who wore the anterior night splint, 89% reported the posterior AFO to be uncomfortable, whereas only 22% of patients wearing the anterior AFO reported it was uncomfortable. The results indicated the anterior night AFO was more effective in the treatment of plantar fasciitis. Roos et al[35] evaluated the effects on pain and function using custom-fitted orthoses and an anterior splint for treatment of plantar fasciitis. They reported pain reductions of 30% to 50% at a 12-week follow-up compared to baseline across all intervention groups. At 52 weeks, a significant pain reduction of 62% was reported for the two groups treated with orthoses (alone or in combination with splint), compared to a 48% pain reduction for the anterior splint alone group.

Table 1. GRADE Evidence Profile: the Effect of Night Splints in the Treatment of Plantar Fasciitis

									Summary of Findings		
A	B	C	D	E	F	G	H	I	J	K	L
Lee et al[39]: Effectiveness of adjustable dorsiflexion night splints in combination with accommodative foot orthosis on plantar fascia											
1	O	Yes (-1)[a,b]	No	No	No	No (U)	28	0	At both 2- and 8-weeks both pain (p=0.01) and total FFI (p=0.01) had significantly lower scores than at baseline in subjects who received accomodative foot orthoses and dorsiflexion night spints. There were no sigificant changes in the subjects receiving only foot orthoses.	VL	(+)
Logan et al[37]: Autologous blood injection and botulinum toxin for resistant plantar fasciitis accompanied by spasticity											
1	O	Yes (-1)[c,d,e]	No	No	No	No (U)	1	0	Ankle and foot were maintained in comfortable range during sleep. Authors suggested night splints were effective in maintaining tissue flexibility.	VL	(+)
Attard & Singh[38]: A comparison of two night ankle-foot orthoses used in the treatment of inferior heel pain: A preliminary investigation											
1	O	Yes (-1)[b,f]	No	No	No	No (U)	15	0	67% of patients who wore AFOs had a decrease in pain. Anterior AFOs placed in a plantigrade position reduced plantar flexion pain more than posterior AFOs placed in a dorsiflexion stretch (p=0.0023).	VL	(+)
Roos et al[35]: Foot Orthoses for the treatment of plantar fasciitis											
1	RT	No	No	No	No	No (U)	43	0	Orthotic, anterior night splint, & combined groups all improved in all 5 subscales of the FAOS* (p<0.04).	H	(+)
Sheridan et al[40]: Plantar fasciopathy treated with dynamic splinting: a randomized controlled trial											
1	RT	No[b]	No	No	No	No (U)	60	0	At 12 weeks the experimental group average score improved by 48% for the Plantar Fasciopathy Pain/Disability Scale compared to the other group (p<0.0001).	H	(+)
Beyzadeoglu et al[36]: The effectiveness of dorsiflexion night splint added to conservative treatment for plantar fasciitis											
1	O	No	No	No	No	No (U)	44	0	Dorsiflexion night splints combined with conservative treatment for 8 weeks improved the AOFAS Ankle-hindfoot Scale (p=0.01) and Visual Analog Scale (p=0.001). This difference was not sustained on long-term follow-up.	L	(+)

A. Number of Studies

B. Design - RT: Randomized trial; O: Observational

C. Limitations - No: No serious limitations; Yes: Serious. [a] Variability of heel pain duration. [b] Activity level of subjects not described. [c] Comorbidity of calf spasticity. [d] Main focus was on autologous blood injection. [e] Treatment timeline not well deliniated. [f] Data on comfort, don-doffing, & compliance were discussed w/o data provided.

D. Inconsistency - No: No serious inconsistency; Yes.

E. Indirectness - No: No serious indirectness; Yes.

F. Imprecision - No: No serious imprecision; Yes: Small sample size.

G. Publication bias - U: Undetected.

H. Number of tested patients

I. Number of controls

J. Summary of findings

K. Quality - H: High; M: Moderate; L: Low; VL: Very low.

L. Recommendation - (++): Strong for; (+): Weak for; (-): Weak against.

Abbreviations: FFI, Foot Functional Index; AFO, ankle foot orthosis; FAOS, Foot & Ankle Outcome Score; AOFAS, American Orthopaedic Foot & Ankle Society

Table 2. Patient Characteristics and Interventions Used to Treat Plantar Fasciitis

Authors, Year	Subjects (M/F)	Age range	Mean age (± SD)	Interventions	Length of interventions	Outcome measurements
Lee et al,[39] 2012	28 (2/26)	30-54	Group A: 43 (5) Group B: 45 (8)	Group A: Accomodative foot orthosis. Group B: Accomodative foot orthosis and adjustable dorsiflexion sock-type night splint at 20° MTP extension and 5° ankle dorsiflexion	8 weeks	Foot Function Index questionnaire
Logan et al,[37] 2006	1 (0/1)	-	18	Autologous blood injections, botulinum toxin injections, adjustable dorsiflexion posterior night splint in neutral ankle inversion and eversion position	unknown	Visual Analog Scale, Modified Ashworth Scale, Observational Gait Scale
Attard et al,[38] 2012	15 (11/4)	26-68	51	Group A: Anterior night splint (foot and ankle in plantigrade position) Group B: Posterior night splint	12 weeks	Numerical Pain Rating Scale
Roos et al,[35] 2006	43 (9/34)	22-63	46	Group A: Custom-fitted orthoses (neutral alignment) Group B: Foot orthoses and anterior night splint, foot at 90° of dorsiflexion (neutral plantigrade) Group C: Anterior night splint, foot at 90° of dorsiflexion (neutral plantigrade)	52 weeks	Foot and Ankle Outcome Score, daily logs for compliance
Sheridan et al,[40] 2010	60 (14/46)	unknown	49.5 (18.2)	Group A: Standard are (NSAIDs, orthoses, and corticosteroid injections) Group B: Standard care, ankle dorsiflexion Dynasplint (initial tension of 2.0 ft-lb of torque)"	12 weeks	Plantar Fasciopathy Pain/Disability Scale
Beyzadeoglu et al,[36] 2010	44 (18/26)	22-44	33.1 (7.7)	Group A: Silicone heel cushion for shoe, silicone heel cushion for slippers, oral NSAIDs, activity modification, stretching exercise, diet for overweight patients (BMI>25) Group B: Same has group A plus posterior night splint at 5 ° of dorsiflexion"	33.2 months	Ankle-Hindfoot Rating Scale and Visual Analog Scale

Abbreviations: MTP, metatarsophalangeal; NSAIDs, nonsteroidal anti-inflammatory drugs; BMI, body mass index

Sock-type Splint

Lee et al[39] evaluated the effectiveness of a soft and self-adjustable dorsiflexion night splint in combination with an accommodative foot orthosis for patients with plantar fasciitis. During baseline and 2-week follow-up, no significant differences were found for pain, disability, or activity limitation. However at the 8-week follow up, significant reductions in pain and total FFI scores were achieved when combining the orthotic insole with the self-adjustable night splint.

Dynasplint

Sheridan et al[40] evaluated the efficacy of stretching with dynamic splinting in patients with plantar fasciopathy who were also receiving standard care (NSAIDs, orthotic devices, and corticosteroid injections if required). At the 12-week follow-up, the group using dynamic night splints in addition to the standard care showed in a significant mean reduction (48%) on the Plantar Fasciopathy Pain/Disability Scale, compared to the group that did not use dynamic splinting.

DISCUSSION

The purpose of this systematic review was to determine the effectiveness of night splints for the treatment of plantar fasciitis. To our knowledge, no other reviews have evaluated this intervention. The evidence presented in this systematic review included 6 papers that implemented 1 of 4 types of night splints: posterior.[36-38] anterior,[35,38] sock-type,[39] or Dynasplint[40] (Severna Park, MD). From the available evidence, it is suggested that in addition to the conservative interventions such as stretches, shoe inserts, night splints, NSAIDs, or injection, the night splints may be helpful in treating the common symptoms of plantar fasciitis.

Plantar fasciitis night splints can control both short-term and long-term symptoms that are most commonly associated with the condition. When wearing night splints the ankles are positioned in a neutral or dorsiflexed position and this angle is maintained throughout the night as the patient is sleeping. This prolonged static position of the ankle is purported to stretch the calf muscles and plantar structures allowing for restoration of flexibility. This increased flexibility is thought to decrease tension on the plantar fascia, thus reducing the common symptoms associated with this disorder.[39,40]

Two papers discussed in this review used posterior-tension splints to maintain ankle dorsiflexion and toe extension.[36,37] This position results in a constant mild stretch of the plantar fascia allowing it to heal at its optimal functional length.[3] Logan et al[37] reported the use of a posterior night splint along with other conservative treatment approaches may help to maintain the flexibility and biomechanical alignment of the plantar fascia (GRADE: very low, weak recommendation for use). Another focus of this paper was on the use of an autologous blood injection in a subject with calf spasticity, which prevented a definitive interpretation on the effectiveness of posterior night splints. Batt et al[29] reported posterior tension night splints in conjunction with a viscoelastic heel pad, stretching program, and NSAIDs were effective in treatment of plantar fasciitis. Beyzadeoglu et al[36] reported the use

of posterior night splints, in addition to other conservative treatment approaches, resulted in significant improvements on the AHRS and VAS short term (GRADE: low, weak recommendation for use). However, the investigators suggest the use of posterior night splints has no significant effect on the long-term recurrence of symptoms.

One paper investigated the use of anterior tension splints.[35] Roos et al[35] reported significant improvements were achieved in FAOS scores when night splints were used alone and in combination with custom-fitted orthoses (GRADE: high, weak recommendation for use). The investigators in this paper suggested patient compliance in wearing anterior night splints is better than for posterior splints because the splint does not need to be removed for walking and in general is more comfortable due to better heat dissipation.

One paper compared the use of anterior and posterior night splints.[38] Compliance seemed to be an issue when using night splints, especially with the posterior night splints. Due to discomfort, night splints can affect sleeping patterns and thus lead to compliance issues. Attard and Singh[38] reported that the anterior night splint, while in a plantigrade position, produced greater reductions in pain compared to the posterior night splint (GRADE: very low, weak recommendation for use). The investigators also reported the use of anterior night splints led to decreased sleep disturbances and was consequently better tolerated by the subjects.

A sock-type night splint is another available option for treatment of plantar fasciitis. Lee et al[39] reported combining an accommodative foot orthosis and an adjustable dorsiflexion sock-type night splint, compared to an accommodative foot orthosis alone, resulted in significant reductions in pain and total FFI scores at an 8-week follow-up (GRADE: very low, weak recommendation for use). Berlet et al[41] reported the use of an Ankle Dorsiflexion Dynasplint is effective in the treatment of recalcitrant heel pain. Sheridan et al[40] suggested the adjustable and soft night splint aids in compliance by decreasing the level of discomfort. Also, in this study the activity level of the subjects was not presented and there was significant variability in the duration of heel pain. The duration of heel pain ranged from 2 to 24 months.

Sheridan et al[40] reported the use of dynamic splinting in combination with standard conservative care produced significant improvements in the Plantar Fasciopathy Pain/Disability Scale (GRADE: high, weak recommendation for use). The investigators suggested the dynamic splints have the ability to maintain tension while the connective tissues adaptively elongate, which is a key difference compared to other types of splinting.

As a particular point of interest, the degree of dorsiflexion used with the night splints varied between the papers selected in this review. Anterior night splints maintained the ankle in a plantigrade position.[35,38] Posterior night splints varied between adjustable (degree not stated), 5° dorsiflexion, and 5° dorsiflexion with 20° metatarsophalangeal extension.[36,37,39,40] Based on the evidence provided, the degree of dorsiflexion did not appear to have a direct effect on the outcomes. Each intervention group that used night splints improved in symptoms.[35-40] The anterior night splints were found to be just as effective, with better compliance, than the posterior night splints. Berlet et al[41] reported common complaints associated with posterior night splints are numbness in the toes, difficulty initiating or maintaining sleep with the splint applied, and perspiration in the splint. Attard and Singh[38] suggested increased stretch on the Achilles tendon may cause increased discomfort with use of posterior night splints. Anterior night splints have a less direct stretch on the Achilles tendon and do not cover as much skin compared to posterior night splints which may lead to the increased compliance.[35,38]

Future research on the most effective positioning when using night splints would be helpful. Additionally, future research into the long-term effects of splinting on the symptoms of plantar fasciitis and the need for a maintenance program might decrease the recurrence rates. Longer follow-up studies, more RCTs, larger sample sizes, use of more functional outcome measures, and further insight into patients' activity levels would also provide valuable information. Obesity is shown to be a risk factor for the development of plantar fasciitis.[3] In the papers selected for this review, patient demographics demonstrated body mass indexes (BMIs) primarily in the overweight category. Future research with a population having a more diverse range of BMIs would aid in the generalizability of the use of night splints for plantar fasciitis. In the studies reviewed, it was apparent there was no consistency in the ankle positions of those who received a night splint as an intervention. The addition of this information could aid in determining the effectiveness of night splints and contribute to their use as an earlier option for patients with plantar fascia symptoms.

LIMITATIONS

This review was limited to papers written in English and published from June 2005 to June 2015. Patients included in the papers were required to be at least 18 years old who had not undergone surgical intervention in their treatment for plantar fasciitis. As a result of these criteria, additional papers may have been missed.

Another limitation was the overall low level of evidence of the 6 papers. Only 2 RCTs were located in our search, with the other 4 being observational papers. There were short follow-ups in all but one of the papers so the long-term effectiveness of night splints is unknown.[36] It is also important to note one paper[37] did not clearly explain the length of time the night splint was used as an intervention, which restricted the utility of their outcomes.

CONCLUSION

This systematic literature review revealed a dearth of evidence supporting the use of night splints for plantar fasciitis. Four out of the 6 papers reviewed provided low level evidence. Patient compliance seems to be an underlying factor with anterior night splints being more acceptable to patients compared to posterior splints. From the available evidence, it is suggested night splints may play a role in alleviating the common symptoms of plantar fasciitis and that the angle of dorsiflexion may not be crucial. However, the evidence is not strong enough to support the use of night splints as the only treatment approach for this foot disorder, but may provide symptomatic relief in conjunction with other interventions.

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Association Among Select Clinical Data and Successful Completion of a Treatment Plan in an Outpatient Orthopaedic Physical Therapy Setting

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ABSTRACT

Outpatient physical therapy treatment and outcome can be influenced by many factors. Variables that influence success need to be identified. The purpose of this study was to determine the relationship of selected clinical variables on discharge success. Data from 669 discharged patients treated at 1 of 3 clinics involving care by 18 clinicians was retrospectively analyzed. Discharge type was operationally defined into 2 discrete categories: normal and abnormal. The results suggested that there was no statistically significant correlation ($p > .05$) between discharge type and any of the following: physical therapist gender, patient gender, patient age, amount of co-pay, physical therapist experience, number of cancelled appointments by patient, number of visits completed, or the number of weeks for total treatment. However statistical significance was found between abnormal discharges and the lumbar spine diagnosis. Statistical significance was also found for average number of visits seen per week per patient. Maintaining a frequency of 2 visits or more per week led to successfully completing the treatment plan 93% of the time with a normal discharge. Further investigation into attendance and treatment success is warranted to optimize patient outcome.

Key Words: attendance, outcomes, compliance

INTRODUCTION

The outcome of a patient's physical therapy treatment in the outpatient setting can be influenced by many variables. Variables such as the age and gender of the patient, diagnosis, compliance with the home program, and/or frequency of visits may play a large part in the end result. The purpose of this study was to determine the relationship of selected clinical variables on discharge success. Identifying the strength of association of these measures with discharge success will help identify indicators that can contribute to "best practice" in the field of physical therapy.

METHODS

Data was collected from 669 discharged patients between the months of January and May 2010. All patients were treated at 1 of 3 clinics involving care by 18 clinicians. Data analysis occurred in June 2010. Therapists were unaware of the study in order to prevent any bias. Each clinician treated their patients autonomously based on an evidence-based approach advocated by each clinic. Once all documentation was completed, signed, and internally audited, the following data were gathered from each patient file:

- Discharge type (normal vs abnormal)
- Patient gender
- Patient age
- Body region treated
- Total visits seen
- Number of cancelled appointments by patient
- Average number of visits seen per week per patient
- Number of weeks actively treated
- Co-pay out of pocket responsibility of the patient
- Physical therapist experience
- Physical therapist gender

Each variable was categorized as nominal, ordinal, or continuous for data entry. JMP version 5.0.1.2 statistical discovery software (SAS Institute, Inc, Cary, NC) was used to enter and explore the data.

Discharge type was broken up into 2 operationally defined categories. They were normal and abnormal.

The operational definition of a normal (or successful) discharge was one where the patient's condition improved to his or her satisfaction, all short- and/or long-term goals were achieved, and discharge was agreeable between patient and clinician. This may include a full return to prior level of function, a partial return to prior level with good understanding between patient and therapist of remaining limitations, or the eventual referral of a patient to the appropriate specialist (eg, orthopaedic surgeon, neurologist, etc). A normal discharge also included a written success story from the patient which is an acknowledgement of the progression of his or her condition from the start of physical therapy to the state of improvement upon the discharge date. This was not a unique variable for the study and represented a normal procedure for the participating clinics.

An abnormal discharge was defined as one where the patient made little or no improvement AND was not a surgical candidate, the patient's condition worsened, the patient self-discharged without meeting clinical goals, or the patient became noncompliant and did not return to therapy.

Patient age was grouped in 10-year increments: 0 to 9 years, 10 to 19 years, 20 to 29 years, and so on. Two patients were under 10 years old, and 4 patients were older than 90.

Body region was defined as the part of the body that was primarily treated. For the purposes of this study, diagnosis was not specified. There were 8 regions categorized as lumbar, cervical, shoulder, knee, hip, foot/ankle, wrist/elbow/hand, and gait/balance.

Total visits seen, total visits cancelled, and total weeks seen were each summed and entered as such.

Physical therapist experience was entered in years and ranged from 0 to 9 years.

Co-pay was defined as the out of pocket expense in dollars incurred by the patient per visit. The following categorical ranges for co-pay were used:

Co-pay Amount in Dollars	Number Assigned to Co-pay Range for Statistical Analysis
$0	1
$1-$10	2
$11-$20	3
$21-$30	4
$31-$50	5
> $50	6

Average number of visits seen per week per patient was calculated by dividing the total number of visits seen by the total number of weeks from initial evaluation to the last visit.

A contingency analysis was then performed to explore the distribution of discharge type across each of the predictor variables of interest. To test for independence of the variables a Pearson Chi Square test of independence was calculated. The p value was established as 0.05.

RESULTS

There were a total of 669 discharges entered, 550 qualified as normal and 119 as abnormal. The percent of normal discharges was 82.2% of total discharges. The variable labeled discharge type was placed in a Fit Y by X model with each other variable in an effort to determine what may contribute to a successful completion of a physical therapy treatment plan.

The results of the statistical analysis suggested there was no statistically significant correlation ($p > .05$) between discharge type and any of the following: physical therapist gender, patient gender, patient age, amount of co-pay, physical therapist experience, number of cancelled appointments by patient, number of visits completed, or the number of weeks for total treatment.

An analysis by body region treated revealed a statistical significance $p = 0.035$ on the Pearson Chi Square statistic between abnormal discharges and the lumbar spine. The percent of abnormal discharges for lumbar spine patients was 25%, compared to an average of 17.8% for all remaining body regions treated.

The greatest statistical significance between any variable and discharge type was that of the average number of visits seen per week per patient, Pearson < 0.0001.

Data on some of the most frequent average number of visits seen per week per patient values are as follows:

Average number of visits seen per week	Successful discharge rate (%)
1.0	48.72
1.33	55.56
1.5	76.92
1.67	69.23
>1.68	92.25
2.0	92.25

From the sample, 251 of the 669 patients were seen 1.67 times per week or less. The successful completion of treatment plan rate for this sample was 64.14%.

A total of 418 of 669 patients were seen 1.68 times per week or greater. This resulted in a successful completion of treatment plan rate of 93.06%.

CLINICAL APPLICATION

The results of this study show a positive correlation between the average number of visits a patient is seen per week and reaching a successful completion of the physical therapy treatment plan as determined by the operational definitions associated with normal and abnormal discharge terms used in this study. Although a number of variables were analyzed, the most significant factor affecting discharge success was frequency of attending treatment. Maintaining a frequency of two visits or more per week led to successfully completing the treatment plan 93% of the time with a normal discharge. We believe that the driving force behind reproducing the desired frequency of treatment each week was patient attendance.

Patients with higher numbers of cancellations or no-shows experienced lower rates of completing their treatment plan with normal discharge. Some research has shown a patient's non-adherence to physical therapy is a multidimensional issue that can affect treatment cost and effectiveness. Several studies have defined many barriers to treatment adherence for outpatient physical therapy.[1,2,3] Jack et al[4] found strong evidence that low levels of physical activity at baseline, poor social support, increased pain during exercise, and other psychological variables such as depression or anxiety were the greatest barriers to successful outcomes. In this study, we did not measure if our physical therapists recognized and helped patients with these issues during treatment thereby influencing their attendance. Low back pain pathologies accounted for 32% of the 669 total patients who were attending therapy. Low back pain was more prevalent in our patients than any other pathology. A lack of specificity in the pathology could lend itself to a greater probability of becoming abnormal when compared to other diagnoses. Furthermore it has been cited that patients who were treated for low back pain showed better results if they were seen early after initial onset.[3,4] Since the time of onset of symptoms prior to initiating the physical therapy program was not included in our data, it is possible that some of the cases may have already become chronic and therefore effected the outcome. Unfortunately, we have no way of knowing if any of these variables (ie, early referral, more specific diagnosis) influenced the data.

It is important to note the relationship between the amount of time a patient's condition has existed and the time elapsed before they seek treatment. In 2012, Fritz et al[1] found that beginning physical therapy immediately after an MD consultation (within 14 days) reduced subsequent health care costs when compared with delayed physical therapy. Initiating a physical therapy program within the first 2 weeks of seeing his or her physician not only made the patient better, but saved the patient and the insurance company money. This is a significant finding that can be used to decrease overall health care spending on things like surgery, injections, advanced imaging, and prescription medications. The study found early physical therapy saved the health care system an average of $2736.23 in medical fees for further management of each individual patient.[1] Comparing this data with the results of our study may suggest a model for frequency and parameters to optimize physical therapy treatment. Those patients who begin physical therapy within 14 days of obtaining a physical therapy referral and are seen at a frequency of twice per week or more are likely to achieve at least 93% successful outcome and save significant additional health care costs.

This issue of chronicity and patient attendance has to be considered when reviewing the results of this study. In 1995, Di Fabio et al[5] found that patients' attendance and the amount of time patients waited to seek care directly affected their ability to get back to work and improve their level of disability. This same claim was found in our study as average number of visits seen per week determined whether the patient successfully completed the treatment plan or not. As physical therapists formulate a plan of care, they are assuming patient attendance will be in accordance with the treatment plan. Our study suggests that in relation to our other data patient attendance is the single most important factor in making sure someone follows through to a completed successful outcome. When a patient is prescribed physical therapy treatments 2 times per week over the course of 6 weeks, the expectation is the patient will be seen for all 12 visits over that 6-week plan. Data from our study shows that if a patient only attends 10 of the 12 visits during a 6-week plan, then an average visit per week total of 1.67 visits over the 6-week plan was achieved. This would result in a 64.14% suc-

cessful treatment plan completion rate. If that same patient attended 11 visits out of the 12 initially prescribed visits over that same 6-week plan, the average number of visits per week would have been 1.83 visits per week with a successful completion rate of 93.06%. This difference supports the importance of maintaining patient attendance even when it means attending one more visit.

While a referral to physical therapy is often dependent on seeing a physician, direct access is one way to allow a patient to get started with therapy as soon as the injury occurs. This option is available in 50 states in the United States at this time. Although the patient bypasses the doctor, there is evidence that supports a physical therapist's importance to act as a "gate keeper" in the health care system. The process is reliant on whether the therapist can accurately define the source of the condition, identify any red flags, and refer the patient to the appropriate specialist as needed. Studies have found that a physical therapist is able to demonstrate competence in differential diagnosis and can coordinate the necessary treatment needed.[5-7] If no red flags are found and the therapist is able to start treatment immediately, the patient has saved time and money. More importantly, the patient may end up with a better outcome.

Achieving an 82% overall successful treatment plan completion rate during the study demonstrated that any given patient (ie, varied diagnoses) was likely to have a favorable outcome. However, those patients who were seen at an average of at least twice per week completed their treatment plan at a rate of 92%. Keeping in mind that the number of visits per week is an average, a therapist can decide to adjust the frequency of visits in order to be sure the average is maintained. It is within the scope of physical therapist practice for the therapist to set and adjust frequency of treatment as part of the plan of care. For example, if a patient is only able to attend therapy once during a particular week, it may be beneficial for him or her to attend 3 times the next week in order to maintain an average of twice per week. The results of this study suggest that controlling the number of average visits a patient attends per week leads to greater outcomes.

The results of this study can be used as a basis for further research. In the future, it may be helpful to break down each normal and abnormal discharge into subcategories based on the definitions presented. A more robust experimental design and statistical analysis may also show a more accurate interplay between variables and their relationship or effect on physical therapy success. Also a 3- and 6-month follow-up could be performed to see if the patient has stayed well or if his or her condition has regressed. Knowing this information can help us better define a patient's true long-lasting effect from physical therapy.

CONCLUSION

The number of treatments a patient attends each week plays an important part in the success of the patient's rehabilitation. Establishing a new patient's treatment frequency at 2 to 3 times a week while ensuring attendance will significantly increase the patient's likelihood of reaching a successful outcome with physical therapy.

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The Role of Therapeutic Neuroscience Education in the Treatment of Foot/Heel Pain in a Recreational Runner: A Case Report

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ABSTRACT

Background: The role of therapeutic neuroscience education (TNE) in the treatment of a recreational runners heel/foot pain. **Case Description:** A 32-year-old female recreational runner presented to the clinic with a recent onset of heel tenderness and foot pain while weight bearing. Interventions consisted of trigger point dry needling (TPDN), eccentric heel raises, and TNE. **Outcomes:** The patient was treated for a total of 4 physical therapy sessions over a 3-week period with an improvement in the Lower Extremity Functional Scale (LEFS) from 46/80 to 80/80. **Discussion:** This case report describes the role of TNE as an adjunct physical therapy treatment and its importance in allowing the patient to return to her prior level of function. The resolution of symptoms and minimal number of physiotherapy treatments suggest the importance of TNE in helping patients understand and manage their own symptoms.

Key Words: orthopaedic, cognitive, manual therapy

INTRODUCTION

Approximately 80% of recreational runners report an injury at some point through their running career.[1] Of these runners up to 30% report heel and foot pain.[2] Research shows eccentric heel raises have some of the best outcomes in relieving Achilles/heel pain if carried out through the entire rehabilitation program.[3,4]

Orthopaedic-based professions commonly use anatomy and patho-anatomy based models to explain pain to their patients. Emerging research shows educating patients about the biological and physiological sources of their pain and how the nervous system/brain processes pain allows patients to move better, exercise better, think different about pain, and push further into pain.[5] Moseley[6] demonstrated evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain (LBP). To our knowledge, no literature has applied therapeutic neuroscience education (TNE) to treat recreational runners with heel/foot pain.

CASE DESCRIPTION

History

The patient was a 32-year-old female recreational runner who presented to the clinic with complaints of heel tenderness and foot pain while running. The patient cited running approximately 30 miles per week consistently for several years. The patient did report a recent fall onto the left sacrum and admitted favoring her left side as a result of the fall for 2 to 3 weeks. Symptoms eventually reduced but she reported several weeks later she began to have foot pain during the warm-up phase of her run. This gradually went away as her running duration increased. After about 10 days of running, the patient had to decrease her pace and walk at the end of an 8-mile run.

Then the patient began to report pain and irritation even with walking especially when barefoot and negotiating stairs. This led the patient to seek physical therapy treatment. During the subjective history review, the patient reported she recently transitioned from a 3 mm to 2 mm heel drop running shoe. She also reported an insignificant episode of similar pain approximately 2 years previously but it was not severe enough to hinder activity. The patient reported she consistently performs a core/hip strength/stabilization program 3 times per week focusing on gluteal activation and lumbar stability exercises.

Examination and Evaluation

During the initial evaluation, baseline measures were recorded to monitor progress and develop a treatment plan. The patient completed a Lower Extremity Functional Scale (LEFS) prior to physical examination. The highest possible LEFS score is 80 points, which demonstrates 0% disability whereas the lowest score of 0 indicates 100% disability. The objective of the LEFS is to measure the "patient's initial function, ongoing progress, and outcome" for a wide range of lower extremity conditions.[7] The minimum clinically important difference (MCID) for the LEFS is 9 points.[7] The patient's score on the LEFS was 46/80. Most affected were lower scores on items related to mobility, recreation and athletic performance. The patient also filled out the Visual Analogue Scale (VAS). The pain VAS is a one-dimensional measure of pain intensity that has been widely used in diverse adult populations.[8] The MCID is 9 mm to 11 mm on 100-mm VAS scale.[9,10] The patient's pain at rest was 20 mm, 65 mm with walking barefoot and performing stairs, and 70 mm with running.

Upon evaluation, the patient demonstrated good anatomical alignment. Range of motion demonstrated equal limitations of 14° dorsiflexion bilaterally. Dorsiflexion was assessed with standard goniometric measurements. Manual muscle testing was 5/5 bilaterally except for left hip abduction and extension 4/5; patient performed 20 single leg heel raises scoring 5/5 on the right lower extremity, but she was unable to perform on left lower extremity due to pain. Double leg and single leg squat demonstrated increased hip and trunk flexion and an inability to squat past 90°.

Palpation demonstrated tenderness and wincing with palpation of the medial/lateral aspect of the calcaneus, gastroc/soleus complex sensitivity, and medial arch pain. The patient was able to balance in single limb standing for >30 seconds with eyes closed but complained of pain in the left foot/heel. Special tests included negative findings on the straight leg raise, FABER test, and spring and Thomas tests. A positive result was found on the Ober test on right lower extremity (Table 1).

Diagnosis and Prognosis

According to the *Guide for Physical Therapist Practice*,[11] the physical therapist diagnosis for this patient fits Pattern 4E since she exhibited impaired joint mobility, motor function and muscle performance, and range

Table 1. Findings of Initial Evaluation

Range of Motion	Lumbar	No restriction
	Hip and Knee	No restriction
	Ankle Dorsiflexion (Knee to wall)	Restricted, painful on left
Gross Manual Muscle Testing	Right Lower Extremity	5/5
	Left Lower Extremity	5/5, Except hip abduction/ extension 4/5
	Plantarflexion	(R) 5/5, (L) Unable
Special Test	Straight Leg Raise	(-) Bilaterally
	FABER Test	(-) Bilaterally
	Spring Test	(-) Lumbar
	Thomas Test	(-) Bilaterally
	Ober Test	(+) On left
Palpation	Medial/Lateral Calcaneus	(+) With wincing left
	Gastroc/soleus Complex	(+) On left
	Medial Arch	(+) On left
Balance	Single Leg Eyes Closed	>30" Bilaterally, painful on left

of motion associated with localized inflammation. At the time of the initial evaluation, the prognosis was good for the patient to return to her previous running mileage and performance levels. Her goals were to return to her previous level of running activity, complete her half marathon training program, participate in an upcoming half marathon, and finish within her goal of half marathon pace with minimal symptoms. Over the 3-week treatment period, objective and subjective measures improved greatly and the patient resumed her half marathon training program.

INTERVENTION

Treatment Sessions 1 & 2

The treating physical therapist's goals for initial manual therapy interventions were to improve soft tissue mobility to help decrease pain levels and safely strengthen gastroc/soleus complex. Manual therapy interventions included trigger point deep needling (TPDN) of the gastroc/soleus complex since this was consistent with referred pain patterns (Figure 1). Dry needling involves the use of a fine filament needle to deactivate a trigger point within a taut muscle band.[12] Classically, described by Travell and Simons[13] a trigger point is the presence of exquisite tenderness at a nodule in a palpable band of muscle.

Following TPDN, soft tissue mobilization was performed on gastroc/soleus and posterior tibialis to help reinforce dry needling and help align collagen fiber orientation. Home exercises included self-mobilization with ankle pump over trigger points of calf (Figure 2). The patient was also given an eccentric heel raise program on a step with knee straight to address soft tissue restriction to complete 3 sets of 15 repetitions per day for 12 weeks (Figure 3) and bridge march for core and glute strengthening (figure 4).[3,4,14] The patient was instructed to ice the region 15 to 20 minutes, a couple times per day if possible and rest from running activities for 10 days.

Treatment Sessions 3 & 4

The patient was treated twice over a 2-week period and reported improvement, minimal foot pain with walking while wearing shoes, and was able to tolerate slow jogging with symptoms 3/10; however, she still reported symptoms with stairs and walking barefoot 5/10.

At this point the patient participated in a TNE program. The TNE can be beneficial in changing a patient's cognition regarding his or her pain state, which may result in decreased fear, anxiety, and catastrophization.[15] As part of the TNE, the patient was educated regarding the body's sensory mechanism and pain as a protective response that is not necessarily harmful. The patient was also educated about pushing to the threshold limits without surpassing limits that would cause damage, breakdown, and increase tissue irritation by going to her pain threshold and not past.

Figure 1. Trigger point dry needling.

Figure 2. Self-mobilization.

Research evidence supports the notion that explaining a patient's pain experience from a biological and physiological perspective and how the nervous system/brain's processes pain enables patients to move better, exercise better, think different about pain, and push further into pain.[16] Patient was shown two drawings and a graph that helps visualize how the patient can learn to help manage the pain (Figure 5).[17] The patient demonstrated an excellent understanding of these concepts after this education session that included teaching the patient that she is in control of her pain and being aware of how long and how fast she can run without irritating her symptoms. The primary instruction focused on the fact that not all pain is harmful and it is ok to push through some pain/irritation.

Following this approach, the patient's gait normalized after approximately 48 hours of completing the session. The patient returned to 5 miles of slow jogging with some symptoms, walked barefoot, and performed steps/

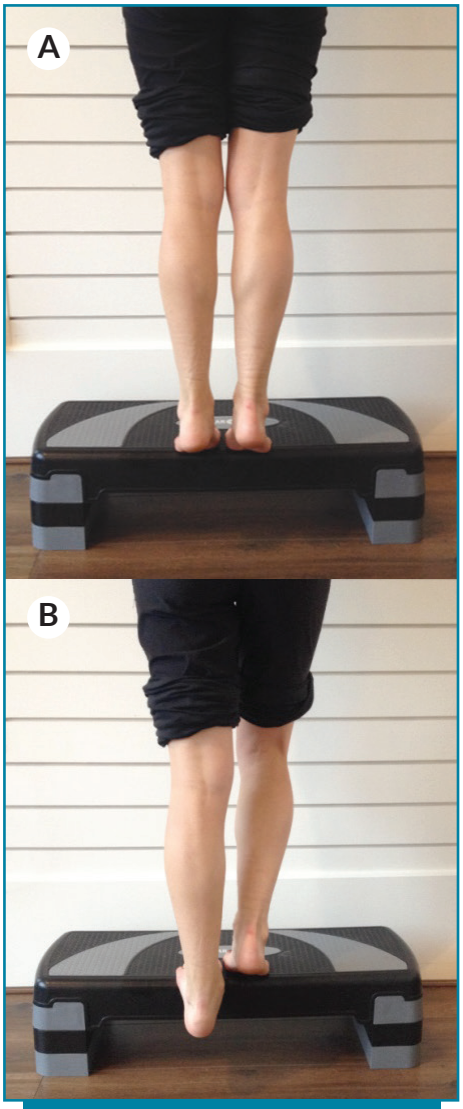

Figure 3. Eccentric heel raise. A, start. B, finish.

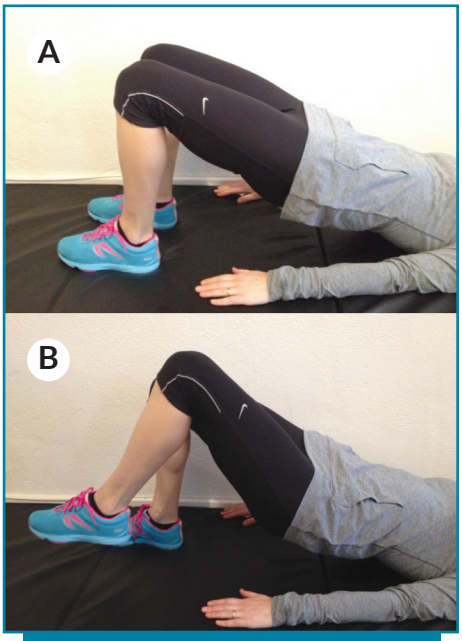

Figure 4. Bridge march. A, start. B, finish.

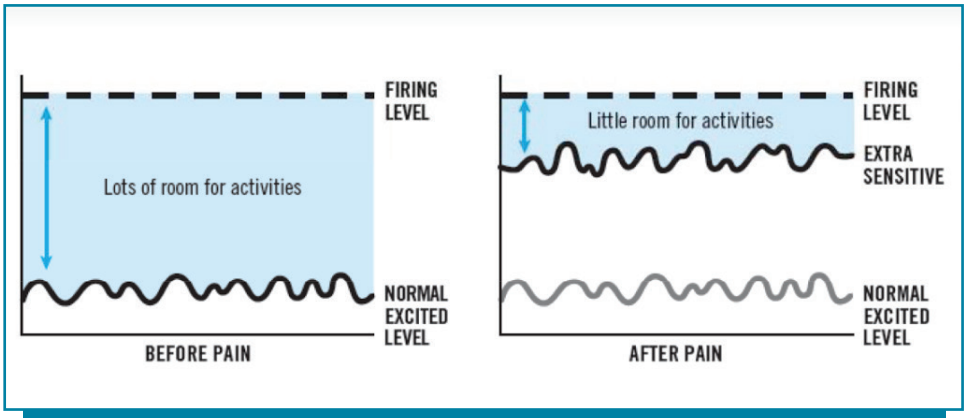

Figure 5. Activity tolerance.

stairs with a non-antalgic pattern and only mild symptoms. By the 4th visit, the patient returned to full activities, including >10 mile run, interval training, and stride training. The patient continued with eccentric heel raises for 12 more weeks following discharge. She returned to using her 2 mm drop shoes for her half marathon race 10 weeks post-treatment and completed the event without issue with a personal best time.

OUTCOMES

The patient was treated for a total of 4 physical therapy sessions over a 3-week period with total resolution of her symptoms Her LEFS score improved from 46/80 to 80/80, which demonstrates the highest possible score and 0% disability. The patient had a 34-point improvement on her LEFS which exceeded the 9-point MCID.

DISCUSSION

The TPDN and eccentric program addressed soft tissue mobility and strength deficits. Eccentric heel raises were chosen as the therapeutic exercise component of the rehabilitation program secondary to the evidence supporting this type of exercise for true tissue elongation and collagen realignment. This would allow the patient to continue to progress to minimal drop shoes without further issue. However even with these interventions, the patient continued to have notable pain with barefoot activities and had not returned to a running program. This case demonstrated a key component of recovery was the patient's own understanding of pain and addressed her fear of symptoms through patient education. The patient achieved a normalized gait pattern once she understood that not all pain is harmful. The authors believe this knowledge and awareness accelerated her recovery. Less than 48 hours after education, the patient believed and understood her condition was temporary and the involved tissue would heal in a timely manner.

The patient was a "type A" personality runner but was educated that injury and pain are two different things. We have nociceptive fibers not pain fibers in our body and the brain decides how to perceive this input based on threat in a given situation.[5] By altering information to the brain the patient better understand her situation and could potentially alter the perceived threat and the patient's overall pain experience allowing her to return to her previous mileage faster. In addition to understanding why TPDN and eccentric heel raises were used in her treatment to address soft tissue/joint limitations, the patient was equipped to understand pain and that not all pain is harmful. This was the final step in the treatment process to address fear expressed by the patient regarding her desire to return to her half marathon training program.

CONCLUSION

In addition to treating the acute musculoskeletal injury and joint range of motion and soft tissue limitations, the adjunct treatment of TNE allowed the patient to understand pain processes of the body and understand the difference between harmful pain and nonharmful pain. The patient returned to running approximately 4 weeks after initial onset. She reported mild symptoms on her first two runs posttreatment but knew not to be fearful of the pain, She now understood she could run through some pain without causing more tissue damage. This case report demonstrated the importance of patient education and patient understanding on the body's sensory mechanism.

Further case studies need to be completed

to address the impact of manual therapy treatments, therapeutic exercise, and the contribution of TNE to the patient's return to activities.

CLINICAL APPLICATION

The author believes therapists need to use all available resources (ie, manual therapy, exercise, education) that can effectively help decrease patients' pain and get them back to optimal function. This case report focused on the role of teaching a patient how to perceive her pain. The author recommends the resource by Louw and Puentedura[5] for further reading in this subject area.

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A Clinical Reasoning Model for Manual Physical Therapy

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ABSTRACT

Background and Purpose: Evidence-based practice and accountability for clinical outcomes are crucial components of professional autonomy. While several clinical reasoning models exist for diagnosing a patient, minimal literature exists on the reasoning models physical therapists use when developing, implementing, and progressing a plan of care. **Clinical Relevance:** An evidence-based approach to the development and implementation of a plan of care can enhance the consistency of how physical therapy is provided across the profession and may improve patient outcomes. This is crucial for further development of evidence-based practice and greater recognition of the profession. One such model for manual physical therapy is Functional Manual Therapy. It is based on an understanding of the human movement system, motor development, and motor learning. **Conclusion:** This model provides physical therapists with a clinical reasoning paradigm for the development, implementation, and progression of a plan of care that can be used across the patient management model.

Key Words: movement system, Functional Manual Therapy, plan of care, physical therapy

BACKGROUND AND PURPOSE

In 1994, Miller[1] described her experience visiting 5 physical therapists (PTs) in search of care for a diagnosed chondromalacia patella. In this *Wall Street Journal* article, the author described how all PTs agreed with the diagnosis but provided vastly differing treatment plans with less than optimal explanations for the chosen interventions.[1] This pattern of comparable diagnosis with vastly divergent treatment plans is not uncommon in physical therapy practice. Some of this disparity may be explained by variability in physical therapy education, clinician bias, a clinician's specialized clinical training, or a combination of the above. In an American Physical Therapy Association (APTA) memorandum, McGehee et al[2] discussed the disparity existent in physical therapy practice as a concern of the profession. While it appears that PTs have become better skilled and more consistent in diagnosing a patient's problems (diagnostic reasoning),[3,4] physical therapy education and the profession lack a common clinical reasoning model for the development and progression of a plan of care (therapeutic or procedural reasoning).[3,4]

Clinical reasoning is defined as a multidimensional process involving cognitive skills to process information, make decisions, and take action.[4-7] Clinical decision making, which results from clinical reasoning, has been described as the "basis of the patient/client management model"[5] and "central to the practice of professional autonomy."[4] Both are crucial components of effective physical therapy practice and Vision 2020.[8] Extensive research exists on the clinical reasoning models used within medical and nursing practices for the primary purpose of clinical diagnosis. These models have been frequently applied to physical therapy education and practice and are reliable models for the differential diagnosis process. However, physical therapy interventions are on-going and must be adaptable at each phase of the plan of care and individualized to the patient's current status. In a time of autonomous practice and a rapidly changing health care environment, PTs are expected to have increased accountability for their decision making while providing clients with robust functional and clinical outcomes in a timely manner. Hence the importance of clinical reasoning models in physical therapy education that extend beyond diagnosis to provide clinicians with a clinical reasoning process that is rational, evidence-based, and easy to implement across the plan of care.

Clinical Reasoning Models Used In Physical Therapy

The patient management model (examination, evaluation, diagnosis, prognosis, plan of care, re-examination)[5] and the International Classification of Functioning, Disability and Health (ICF)[9] have provided PTs with a common language and a strong framework for clinical decision making aimed at addressing all levels of human function (body structure and function, activity, and participation).[10] These models have been instrumental in the development of the profession's preferred practice patterns, outlined in the original *Guide to Physical Therapist Practice*,[11] which provided a list of possible interventions for specific clinical presentations. Several articles have described the importance of connecting the patient management model and the ICF model to the clinical reasoning process used in clinical practice.[3,10,12,13] However, none have provided a reasoning process for treatment progression.

The most common clinical reasoning models described in the medical literature include hypothetico-deductive reasoning (backward reasoning), pattern recognition (forward reasoning), narrative reasoning, dialectical reasoning, collaborative reasoning, and diagnostic reasoning.[3,4,6,7,14] These models are effective and have been widely used in physical therapy practice for the diagnosis phase of patient care. Extensive information is available on the difference between an experienced clinician's use of pattern recognition and reflection-in-action with increased reliance on directive factors and a novice clinician's s use of hypothetico-deductive reasoning and reflection-on-action with increased reliance on informative factors for clinical decision making.[15,16] These various medical reasoning models for diagnosis have provided a valuable framework for the physical therapy profession for many years helping advance the profession towards direct access.

In addition, Edwards et al[3] have proposed a model of clinical reasoning for PTs based on two clinical reasoning strategies: one for addressing diagnosis and another for patient management. *Diagnostic reasoning* (the formation of a diagnosis based on physical disability and impairments while taking into consideration tissue pathology, pain mechanisms, and other contributing factors) and *narrative reasoning* (the inclusion of the patient's experiences, beliefs, and cultures into the decision making process) make up the strategy for diagnosis.[3] The patient management strategies include *reasoning about procedure* (the reasoning involved in choosing and carrying out an intervention procedure), *interactive reasoning* (the on-going develop-

ment and management of patient-therapist rapport), *collaborative reasoning* (collaboration in all aspects of examination, evaluation, development and implementation of a plan of care), *reasoning about teaching* (educating the patient in aspects of clinical practice), *predictive reasoning* (the exploration of future scenarios with patients), and *ethical reasoning* (assessment of the ethical implications of clinical interventions and its desired goals).[3] However, while PTs know intervention techniques should most often be chosen based on the identification of body structure or functional impairments and patient preferences, a rationale for the **sequencing** and the **progression** of interventions across the plan of care remains unclear. This lack of clarity contributes not only to a clinician's challenge in developing the progression for a plan of care but also to the existing differences in how patients are treated by different PTs. This discrepancy in patient care may very well contribute to the difficulty the profession experiences in objectively measuring and documenting outcomes across the profession, further contributing to the profession's poor recognition within the medical and public communities. Physical therapists must go beyond the diagnosing of a patient. Clinicians must have the reasoning tools necessary for the development, implementation, and progression of a sound treatment plan. The remainder of this paper will present a physical therapy clinical reasoning model for the development, implementation, and progression of a plan of care, Functional Manual Therapy (FMT), along with clinical scenarios illustrating the application of this model.

Functional Manual Therapy: A Clinical Reasoning Model for Physical Therapy Intervention Based on the Movement System

While delivering the 29th Mary McMillan lecture at the 1998 annual American Physical Therapy Association (APTA) conference, Shirley Sahrmann,[17] describing the basic definition of physical therapy, stated, "we must solidify our identity as a profession by developing the concept of movement as a physiological system and by accepting the role of practitioners responsible for a system of the human organism." The APTA's current vision statement, "Transforming society by optimizing movement to improve the human experience," notes that the "physical therapy profession will define and promote the movement system as the foundation for optimizing movement to improve the health of society."[8] At the 2015 APTA Annual Conference, Delitto[8] discussed the need for the human movement system to be part of physical therapy education, supporting the APTA vision that the movement system is the core of physical therapy practice, education, and research.[8] As a result of these efforts, the APTA has put forth a white paper proposing that PTs are indeed the experts of the movement system and further stating, based on our extensive understanding of the complexity of the human movement system, PTs should provide a "customized and integrated plan of care to achieve the individual's goal-directed outcomes."[19] It states dysfunction across a variety of body systems may indeed contribute to movement dysfunction and must therefore be addressed as part of the physical therapy examination and intervention.[19]

The FMT approach to physical therapy supports this vision and proposes a clinical reasoning model that is grounded on the individual patient and on our understanding of the movement system. Functional Manual Therapy suggests that the development and implementation of a treatment plan based on the physical therapy examination must include an integrated treatment progression within each session and across the episode of care. This progression must be based on an understanding of normal movement and must be, as described by the *Guide to Physical Therapist Practice*, "contingent on the timely monitoring of patient/client responses to interventions and on the progress made toward anticipated goals and expected outcomes."[11]

Among the components of the movement system that are implicit to the FMT clinical reasoning model are an understanding of anatomy, physiology, kinesiology (including osteo- and arthro-kinematics), normal motor development, the components of movement (mobility, stability, controlled mobility and skill)[20,21]; motor learning theories, patient examination and evaluation, and the skilled observation and palpation of functional motor tasks. Within FMT, movement and functional efficiency is the primary goal. Rosenbaum[22] describes movement efficiency as one that reduces stress on joints and muscles, allows for a high rate of success with few errors, is smooth and easy, and requires the least cognitive processing. Functional Manual Therapy embraces this concept and operationally defines "functional efficiency" as *the sufficient mechanical capacity (M), neuromuscular function (N), and motor control (M) to allow for options of strategies in the performance of any given action or task*.[23] The FMT clinical reasoning model is designed to restore and enhance human movement and function through the systematic examination and treatment of these three pillars of movement: the **M-N-M model**[23] (see Table 1 for operational definitions of the M-N-M pillars and the types of interventions used within each pillar). Based on an understanding of normal motor development and the interdependence of these pillars of movement, FMT proposes a sequence/progression for the examination and treatment of the impairments identified in each patient within each segment (local), across segments (regional), and across the whole body (global). Unique to the FMT paradigm is the concept of *local interdependence*, which expands on the concept of regional interdependence to address the 3-dimensional inter-relationship of the 3 pillars of movement within each segment of the body. Local interdependence is integral to regional interdependence, which is defined as "the concept that a patient's primary musculoskeletal symptom(s) may be directly or indirectly related or influenced by impairments from various body regions and systems regardless of proximity to the primary symptom(s)."[24] In other words, local dysfunctions must be addressed 3-dimensionally and across all systems so local functional efficiency is available for regional efficiency. By addressing local and regional dysfunctions and considering their interdependence, FMT aims to reinstate the coordinated synergistic strategies of mobility and stability that are inherent in normal growth and development and remain crucial to all motor learning across the lifespan.

The Functional Manual Therapy Paradigm for Examination, Evaluation, Diagnosis, Prognosis, and Intervention

A patient's FMT examination encompasses: (1) past medical and surgical history; (2) an extensive subjective history including history of current episode; (3) the observation and assessment of posture and functional movement patterns; (4) the identification of pain producing motions; (5) the identification of anatomical structures sensitive to palpation; (6) the assessment of local, regional, and global mechanical capacity; (7) the assessment of neuromuscular function of individual and synergistic movement patterns; and (8) the analysis of functional tasks. Examination results are evaluated to determine local and regional dysfunctions across the M-N-M paradigm. These are integrated with the patient's subjective history and functional skills to determine the physical therapy diagnosis and prognosis incorporating all

Table 1. Components of Efficient Movement: Mechanical Capacity, Neuromuscular Function, Motor Control (MNM)[23]

Components of Normal and Efficient Movement and Examples of Intervention Techniques	Definition
Mechanical Capacity (M) **Techniques:** functional mobilization, joint mobilization, joint manipulation, soft tissue mobilization, neural/vascular mobilization, stretching, mobilization with movement, myofascial release, etc.	Mechanical capacity refers to the quality and excursion of movement and the ability to attain functional postures. This includes mobility of joints (arthrokinematics, osteokinematics, and accessory motions) and soft tissues (skin, muscles, connective tissues, neurovascular structures, and viscera). A springy end feel, defined as the presence of an elastic recoil at the end motion of a joint or soft tissue, is indicative of the efficient state of mechanical capacity. - All tissues are examined in 3 dimensions and in various functional positions taking into consideration the location, the depth and the direction of any noted restrictions. This allows for individual variability in what is considered inherent efficient mechanical capacity. - In the FMT reasoning model soft tissue restrictions are often treated prior to joint restrictions. This sequencing allows the environment surrounding a joint to have the necessary freedom for mobility gains in the tissues treated.
***Neuromuscular Function (N)** **Techniques:** Initiation: Largely performed through PNF based techniques including, but not limited to prolonged isometric holds at the end of the range of motion; irradiation from a stronger source muscle; isotonic reversals, repeated quick stretches, etc. Strength: resistance through movement. Endurance: repetition of movement.	Neuromuscular function refers to the neurophysiological ability of synergistic muscles to initiate a contraction with proper strength and endurance for the given task, including the ability to return to a state of muscular relaxation. - The PT assesses the neurophysiological capability to initiate a muscle contraction with appropriate timing and magnitude, focusing on specific types of contractions (isometric vs isotonic). Hodges[27] has shown that once inhibited by pain or dysfunction, a muscle may not be able to initiate a contraction without specific facilitation of that contraction. This body of literature supports the need for facilitation techniques that are specific not only to the inhibited muscle or muscle group, but also to the type of muscle fibers that may have been inhibited (tonic vs phasic). Once a muscle is able to initiate a contraction, strength and endurance can be worked on. An efficient tonic/stabilizing muscle contraction, with proper timing, is necessary for efficient functional movement to be performed by the larger phasic/global muscles. Lastly, the ability to 'let go' or to relax a contraction is a learned motor behavior that must be re-instated in order for efficient function to be restored. - Consider patients with protective spasms secondary to low back pain or those who have suffered a stroke or a head injury without the ability to relax muscles that are hyperactive or hypertonic. Or the patients who have learned inefficient movement patterns (incorporating protective muscle spasms) that become part of a functional repertoire as a result of repetition. Relaxation of inefficient muscle contractions must be re-instated.
Motor Control (M) **Techniques:** Functional re-education, task specific training, etc.	Motor control refers to "the ability to learn and perform the skillful and efficient assumption, maintenance, modification and control of voluntary movement patterns and postures."[29] In addition to the fundamental goal of independence in functional skills, the FMT paradigm promotes the establishment of functional efficiency for the accomplishment of independence in functional skills with coordinated purposeful movement. In the FMT system, motor control addresses one's ability to integrate efficient mechanical capacity and neuromuscular function for efficient functional movement. It refers to one's ability to coordinate local (stabilizing) muscles with global (moving) muscles to produce functional movements that demonstrate dynamic proximal stability and efficient distal mobility with proper timing for functional activities. The smoothness and coordination of the desired movement is of utmost importance. Tasks are progressed from simple to complex leading to skilled functional movements. The ability to habitually utilize the most functionally efficient movement strategy, out of all available options, is the ultimate goal.

Abbreviations: PNF, proprioceptive neuromuscular facilitation; PT, physical therapist; FMT, functional manual therapy
* All aspects of the FMT model are reinforced with very specific exercises assigned following each session as part of a focused home exercise program.

aspects of the bio-psycho-social model of pain management.[25] A plan of care is then developed to promote functional efficiency and independence in functional skills with coordinated purposeful movement. As described in the case of a triathlete diagnosed with chronic exertional compartment syndrome,[26] interventions for each of the M-N-M pillars are continuous and seamlessly used during each treatment session and across the episode of care to restore functional efficiency at the local and regional levels of interdependence. Every treatment session beyond the initial evaluation incorporates a continuous and seamless interaction between examination, clinical reasoning, and intervention.

Treatment progression strategies depend on whether the focus is local, regional, or global. Inherent within the *local progression* is the systematic assessment and management of surrounding soft tissues prior to progressing to the mobilization of joints, while *regional progression* is based on the understanding that the evaluation and treatment of key struc-

tures can accelerate the enhancement of posture and movement across segments, and the *global progression* is addressed by evaluation and treatment of structures that can impact the patient's ability to attain a balanced posture for functional movement. An individualized, continuous and seamless examination and evaluation, re-examination and re-evaluation, allows for the development and implementation of a patient-specific treatment plan progression. Treatment techniques are used to address each component of the FMT paradigm as indicated: **M**echanical capacity dysfunctions can be treated with functional mobilization techniques for joints, soft tissue and fascia, neural tissue, and other mobilization techniques aimed at releasing restricted tissue. Dysfunctions in **N**euromuscular function can be addressed with facilitation techniques aimed at eliminating muscle inhibition by restoring the ability of a tonic or phasic muscle (or muscle group) to initiate and terminate a contraction and to develop strength and endurance. Only then can **M**otor control be addressed through activities aimed at restoring function and promoting transfer of learning.

As illustrated in clinical scenarios 1 and 2 (Table 2 and 3), the FMT clinical reasoning process used to determine how to begin and progress a treatment plan requires that the clinician identify the M-N-M pillar affected and then choose appropriate intervention techniques for each segment and across segments. If a patient presents with complaints of hip pain related to walking or running, demonstrating inefficient weight shift and weight acceptance on the affected lower extremity (LE) during stance, the clinician must assess for, and treat, the mechanical capacity of all aspects of the lower quadrant to assure the patient can weight shift and weight accept onto that LE without compensations or dysfunctions. Once mechanical capacity of the restricted segment (including superficial fascia, skin, muscle, neurovascular tissue) is restored, it is imperative that neuromuscular function (initiation and relaxation of a contraction, strength and endurance) be addressed immediately and in a manner very specific to where a deficit may have been present. The importance of facilitating one's ability to initiate a contraction into a new range of motion or to initiate a contraction that may have been inhibited by pain or inefficient function is supported by the findings of Hodges et al[27,28] that the inhibited muscles do not return to normal function unless specifically facilitated to do so. Based on the FMT clinical reasoning model, it is only when proper initiation has been facilitated, with adequate strength and endurance, that the segment can be progressed to the motor control pillar where functional movements are learned and practiced and transference of learning is possible. It is important to note the assessment and treatment of the M-N-M pillars of movement is not a linear process but instead, it is a continuous assessment and reassessment of the interdependency between these pillars of functional movement, which must occur within each treatment session.

Table 2. Clinical Scenario 1

Clinical Scenario 1
The patient is a 15-year-old soccer player presenting 4 months following a left lateral ankle sprain. The patient reports she no longer has any pain but has difficulty with running and any cutting during games and feels decreased power in push-off when attempting to run harder. The interview reveals no past history of trauma and no complaints prior to this injury. Physical therapy examination reveals decreased DF mobility to 5° with a hard end-feel. Single limb stance is unstable and limited to 15 seconds. An observational gait analysis reveals decreased weight shift and acceptance onto the LLE, decreased stance time when compared to the R, absent L push-off with minimal engagement of the L pelvis into push off. Joint mobility assessment reveals decreased posterior and medial glide of the talus limiting DF mobility. **Clinical Reasoning:** This seems like a straightforward case of a lateral ankle sprain leading to decreased talus mobility affecting DF ROM and limiting the patient's ability to stand effectively onto that LE. A treatment plan aimed at restoring the mobility of the talus followed by therapeutic exercises focused on balance and strengthening would seem appropriate and is the most likely traditional physical therapy plan of care. However, as simple as this case appears to be, lateral ankle sprains recur at a rate of 80%[30] questioning the efficiency of traditional physical therapy in these cases. **FMT Clinical Reasoning Model:** the decreased mobility of the talus must indeed be addressed for increased ankle DF motion. However, an assessment and treatment of the mechanical capacity (M) of the calcaneus, the tibia, and the fibula must be considered to assure the functional efficiency of this segment. Adequate mechanical capacity in the surrounding articulations as well as the surrounding soft tissues and neurovascular tissues must be present to allow for the mobilization of the talus. Once mechanical capacity of the talus is addressed in an open chain position, facilitation techniques must be used to engage appropriate muscle activation across the ankle joint within the newly gained range of motion. This assessment must incorporate weight-bearing positions to assure that full mobility is restored proximal to distal and distal to proximal addressing regional interdependence across the lower quadrant. In other words, intra-segmental patterns of restrictions may have developed following the original injury and the extremity must be examined and treated as a whole when attempting to restore function at the ankle. Techniques aimed at facilitation of muscle contractions at the end of the newly gained ROM are used in open and closed chain activities to assure proper neuromuscular function. At this point the patient is instructed on functional movement patterns aimed at restoring motor control for functional activities. In this case the patient will be instructed on activities aimed at improving weight shift and weight acceptance onto the LLE while using the newly gained ROM and neuromuscular function across the lower quadrant and, specifically, the ankle. A home exercise program is prescribed so that through continuous repetition the patient will achieve proper activation of muscles for strengthening and functional re-training of the entire LE in a weight-bearing position with proper weight acceptance and active push-off initiated from the trunk and pelvis. This clinical reasoning process and the interventions that follow should occur throughout the episode of care assuring that passive mechanical capacity is restored and active neuromuscular control is trained 3-dimensionally and in stages across each treatment session progressing the patient towards full return to painfree function, in this case, playing soccer.
Abbreviations: DF, dorsiflexion; L, left; R, right; LE, lower extremity; ROM, range of motion

Table 3. Clinical Scenario 2

Clinical Scenario 2
The patient is a 24-year-old male pitcher in a college baseball team presenting with recurrent R shoulder pain that has limited his playing time for the last year. In each occurrence the patient was treated by the team PT and athletic trainer with ice, massage, soft tissue and joint mobilization, and strengthening to the shoulder and the UQ. Each episode of care was successful in relieving pain and getting the patient back on the field. However, pain recurred after pitching in 2 to 3 games, thus necessitating the patient being placed on the injured list unable to participate in the sport. The patient presents with decreased shoulder flexion and abduction secondary to anterior deltoid pain, which is exacerbated by resistance or manual palpation. The patient has no limitations in functional ROM but slightly decreased posterior and inferior glide of the humeral head on the glenoid fossa are noted. **Clinical Reasoning:** A treatment plan aimed at addressing the localized pain and decreased mobility with modalities, joint mobilization, soft tissue mobilization and strengthening of the upper quadrant and the shoulder would seem appropriate for the local dysfunction and symptoms described by the patient. The continued recurrence of symptoms, however, indicate that the source of the dysfunction may be elsewhere explaining why local treatment may get the patient back on the field but is not sufficient for keeping him painfree and playing. **FMT Clinical Reasoning Model:** While local treatment may be effective in addressing the local symptoms, this presentation requires a thorough examination and evaluation of the patient's pitching technique to determine the primary source of dysfunction that could be affecting the local shoulder dysfunction. It is possible that dysfunction elsewhere might be the driving force of the local symptoms as explained through the concept of regional interdependence.[24] A thorough observation of the patient performing the pitching motion reveals that the left ankle has decreased active motion during the deceleration and follow through phases of pitching. Thus, causing the patient to compensate by moving excessively through the shoulder. A careful examination confirms decreased mechanical capacity of ankle DF and inversion. Following the M-N-M model of FMT, a thorough examination of the LE reveals restricted mechanical capacity of the midfoot, calcaneus, talus, tibia, hip, and lumbo-pelvic girdle. A POC based on the FMT clinical reasoning model is developed to address the limited mechanical capacity of all segments of the LE in an OKC as well as in a CKC to progress to neuromuscular function of the newly gained ROM and is reinforced by a HEP. All treatment sessions are followed by a HEP with few but very specific exercises aimed at practice and repetition of the newly gained motion through functional exercises emphasizing motor control. It is only when all mechanical capacity and neuromuscular function deficits across the lower quadrant have been addressed that physical therapy can progress to interventions aimed at the affected shoulder and the upper quadrant. The final stages of the POC, when mechanical capacity and neuromuscular function of the entire UQ has been restored, will focus on the motor control pillar aiming to restore functional efficiency beyond the local and regional segments to restore the integration of all segments with functional efficiency at the global level for the task of pitching.

Abbreviations: R, right; PT, physical therapist; UQ, upper quadrant; ROM, range of motion; FMT, Functional Manual Therapy; DF, dorsiflexion; POC, plan of care; LE, lower extremity; OKC, open kinetic chain; CKC, closed kinetic chain; HEP, home exercise program

DISCUSSION AND CONCLUSION

In summary, physical therapists must possess the ability to develop a plan of care that is based on a sound clinical reasoning model aimed at restoring painfree function if we are to provide our clients with robust outcomes in a timely manner. The FMT clinical reasoning paradigm presents a reasoning process in which the therapist is guided to specifically and seamlessly cycle the examination and intervention, addressing every aspect of the patient management model in every treatment session. Underlying this paradigm is the inherent guiding principle of determining and re-establishing the interdependent relationship of the body's **M**echanical capacity, **N**euromuscular function, and **M**otor control. It proposes a treatment progression and clinical reasoning process that must be applied to each individual treatment session as well as to the entire plan of care aimed at facilitating 3-dimensional mechanical capacity locally and regionally with appropriate neuromuscular function and motor control for the restoration of functional efficiency and painfree living.[23] The ability to hit-the-ground running, as physical therapy graduates are expected to do today, requires that clinicians possess not only a strong knowledge of the human movement system, and all the techniques and approaches covered in a physical therapy curriculum, but also the ability to think through and progress a treatment plan. The FMT clinical reasoning paradigm does not require extensive clinical experience. Instead, it provides the new graduates and advanced clinicians alike with a reasoning paradigm that can be used at any level of clinical experience or expertise. It is the toolbox that holds and supports all of our clinical tools.

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The Effects of Varying Hip Flexion and External Rotation Angles on the Production of Isometric Hip External Rotation Torque in Healthy Adults

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ABSTRACT

Background and Purpose: Strength of the hip external rotators is related to injuries of the lower extremity. Research has shown there is an inverse relationship between hip external rotation (ER) torque and hip flexion angle. Little research has addressed torque production in relation to hip flexion and hip ER angles. **Methods:** A sample of 20 adults from Saint Francis University volunteered for this repeated measures design study. The average peak external rotator isometric torque was assessed over 3 trials in 12 different positions using an isokinetic dynamometer. Testing positions for each subject were randomized. **Findings:** No statistical significance was found between hip ER torque and the varied hip flexion angles. Hip external rotation angle produced a statistically significant difference in peak hip external rotation torque production. **Clinical Relevance:** The study results are relevant to the manner in which the external rotators are strengthened and manually muscle tested. The results also discuss the possible incompatibility of using a standard elastic band in relation to a common ER strengthening exercise. **Conclusions:** It is advantageous to know muscle strength performance as a function of joint position to appropriately test and implement the therapeutic exercise.

Key Words: biomechanics, muscle testing, length-tension relationship, strength curve

INTRODUCTION

Hip external rotator strength has been found to be an important aspect of patient mobility and function. The hip external rotators have a primary role in controlling the lower extremity. Increased strength in hip external rotator musculature has been shown to be a factor in preventing valgus collapse of the lower extremity and minimizing gait deviations.[1,2] Research has shown that specific injuries such as patellofemoral syndrome can be a result of poor external rotator strength.[3] Because of the muscles' importance in maintaining proper lower extremity positioning and prevention of injury, it is imperative that physical therapists evaluate external rotation. Currently, a common method to measure external rotation strength is by performing an isometric manual muscle test with the patient in the seated position with 90° of hip and knee flexion.[4,5]

One of the main external rotators in the hip is the gluteus maximus. According to Neumann,[6] 71% of the gluteus maximus muscle fibers produce force in the horizontal plane, making it a major contributor to external rotation at the hip. The gluteus maximus is one of the external rotator muscles that can change its line of pull depending on the position of the hip.[6-8] According to previous research, the hip external rotators produce the greatest force when the hip is positioned in 0° to 40° of hip flexion.[7,9,10] Prior to reaching 40° of hip flexion in the sagittal plane, the line of pull of the muscle fibers are more posterior causing an external rotation moment. After 40°, the line of pull of these fibers moves anteriorly to the joint axis thereby causing an internal rotation moment.[6-11] Increasing hip flexion angles may result in a loss of external rotation mechanical advantage by the gluteus maximus.

In order for contractile tissue to create maximum torque, the muscle tissue has to be positioned at an optimal length. This theory states each muscle fiber has a position where the length is not too short or long and can produce the greatest torque. Since the research states that testing greater than 40° of hip flexion creates a disadvantage to the hip external rotators, it is questionable as to why clinicians test hip external rotation (ER) strength while the hip is flexed to 90°. There is little research testing hip ER strength throughout the range of 0° to 90° of hip flexion. Based on the anatomy of the hip musculature, hip ER strength should be greater when the hip is in less than 40° of hip flexion. Evaluating the external rotators of the hip in a smaller angle of hip flexion could give a more accurate display of hip ER strength.

The authors of the current study propose that hip external rotation isometric strength will be greatest at 30° of hip flexion with 15° of hip internal rotation. Although there is no research focusing on the ER aspect, it was added to this study because traditional manual muscle testing of the external rotators involves a position of full ER. This actually shortens the muscle and, combined with increased hip flexion, puts the external rotators at an almost impossible position to produce their greatest force. The purpose of this study is to determine the effect of changes in hip flexion angle and ER position on the isometric torque production of the external rotators.

METHODS

Subjects

A sample of 20 healthy adults (11 male and 9 female) from Saint Francis University volunteered for this repeated measures design study. Individuals were eligible for the study if they were between 18 and 64 years old, had at least 0° to 100° of hip flexion, and had 0° to 20° of hip ER in the dominant leg. Exclusion criteria included any hip or knee injury within the past year, surgery to the lower extremity within the past 2 years, patellofemoral pain syndrome, hip dysplasia, ligament or meniscal tear/reconstruction, hip/knee osteoarthritis, significant pain rating a 3 out of 10 or higher on the pain scale, and any significant heart condition that could have been exacerbated by strength testing. No subjects were excluded from the study.

Procedures

The study was conducted by 6 student physical therapists from Saint Francis University, under supervision from their research advisor, and was approved by the Institutional Review Board (IRB) at the University. All testing took place at the Disepio Institute for Rural Health and Wellness Physical Therapy Clinic at Saint Francis University. Multiple training sessions practicing the following procedures and familiarizing with the

appropriate equipment were conducted prior to subject data collection.

Subjects were first asked to complete an informed consent document as well as a basic demographic survey inquiring about height, weight, past injuries/illnesses, and other medical conditions that could compromise patient safety. Each subject's hip range of motion (ROM) was screened in order to ensure he or she met the proper inclusion ROM criteria. Leg dominance was then tested by rolling a kickball to the subject and having the ball kicked for a total of 3 trials; the dominant leg was considered the leg to kick the ball on 2 out of the 3 attempts. Out of the 20 participants, 19 individuals were determined to be right leg dominant, while only one participant was determined to be left leg dominant. The volunteers were placed in one group and taken through each position of hip flexion and hip ER which involved a total of 12 positions. All subjects pulled an index card indicating the order in which they would perform each position in order to prevent bias to fatigue and to add randomization. The subjects performed 3 trials in each of the 12 positions and the mean peak torque represented the subject's score.

Each subject participated in a 5-minute warm up on an upright stationary bike at a comfortable speed. After completion of the warm up, each subject's isometric strength of the hip external rotators was measured in a total of 12 different testing positions using a Biodex isokinetic dynamometer.[12,13] These positions included the following: 0°, 30°, 60°, and 90° of hip flexion in 15° of hip internal rotation, neutral (0°) rotation, and 15° of hip external rotation. Three trials of 5-second isometric holds were recorded in each testing position, with 30 seconds of rest between each trial. Each subject's starting position was randomized in order to prevent skewed results secondary to patient fatigue. The subject's isometric peak torque was calculated as the mean of the 3 trials and then normalized based on the mass to eliminate strength differences due to bodyweight.

Data Analysis

Data were analyzed using Minitab 17 (State College, PA). A two-way (hip flexion x hip ER) repeated measures analysis of variance (ANOVA) was performed on normalized joint torque data for hip ER to determine if hip angle resulted in changes in the torque. Interaction effects (hip flexion x hip ER) took precedence over main effects in the statistical model. Post-hoc pair-wise comparisons were performed using the Tukey method to evaluate variations in torque across rotation angles.

RESULTS

Twenty subjects (11 males, 9 females) met the inclusion criteria. Their mean age was 21 years with a standard deviation of 2.1 years. The torque data of each subject was normalized to body mass. The mean peak hip ER torque was found to be 0.43 Nm/Kg at the (-15°) hip ER position and with the hip flexed to 60° (Table 1). All mean peak hip external rotation torques at (-15°) of rotation were greater than 0° of rotation, which were subsequently greater than 15° of external rotation. Statistical analysis showed there was no significant difference between hip flexion angles on external rotator torque ($P = 0.28$). However, there was a significant difference with the angle of hip ER on hip external rotator torque ($P < 0.001$). Tukey pairwise comparisons showed significant differences between hip torque at each of the ER positions (-15°, 0°, and 15°).

DISCUSSION

Manual Muscle Testing

This study demonstrates, in the transverse plane, the hip external rotators produced the greatest torque when they are positioned in -15° of hip ER; in other words, an internally rotated position. The least torque was produced when positioned in 15° of hip ER. This confirms the hip external rotators are capable of producing their greatest torque when in a slightly lengthened position, as opposed to when they are placed in a neutral or slightly shortened position. According to the length-tension relationship, a muscle is at its optimum position in a slightly lengthened position to produce its greatest torque.[14] The results of this study clearly demonstrate this for the torque assessment of the hip external rotators, asserting a decreasing linear progression of the isometric torque-angle relationship to the hip position with the hip in internal rotation being the strongest, followed by the neutral and then the externally rotated positions.

The current standard protocol for manual muscle testing according to Daniel and Worthingham is that the hip external rotators are to be prepositioned in a maximally shortened position.[4] This proposes the question as to whether or not these muscles should continue to be tested in a shortened position, or whether they should be tested in a neutral or more lengthened position. If the hip external rotators are to be tested using the standard protocol, the results may be flawed due to the fact that the muscle was not placed in the most optimal position to produce maximum torque. If the hip external rotators were to be tested in a position of slight internal rotation, then the results provided would coincide with the maximum isometric torque that the external rotators could produce and a more functional position in which they should be preventing injury.[2] Inevitably, the results would provide the clinicians with the most accurate measurement of an individual's strength.

Therapeutic Exercise

A typical hip external rotator exercise involves an individual seated, with the hip and knee both positioned in 90° flexion, pulling into external rotation against the resistance of an elastic band (Figure 1). The results of this study show the external rotators may not be strengthened as efficiently as possible with this exercise. By using elastic bands, the band is on slack when the muscle is at its strongest position (ie, internal rotation). As the patient moves into the external rotation position, the band becomes more resistant as the length tension relationship puts the external rotators in a less efficient position to produce a great amount of torque, and the exercise becomes more dif-

Table 1. Mean Peak Torque (Nm/Kg) ± Standard Deviation

External Rotation Angle	Hip Flexion 90°	Hip Flexion 60°	Hip Flexion 30°	Hip Flexion 0°	Mean	p-value
-15°	0.41 ± 0.09	0.43 ± 0.12	0.40 ± 0.11	0.40 ± 0.09	0.41 ± 0.10	<0.001*
0°	0.34 ± 0.07	0.34 ± 0.13	0.33 ± 0.09	0.33 ± 0.07	0.34 ± 0.09	<0.001*
15°	0.24 ± 0.07	0.26 ± 0.11	0.24 ± 0.08	0.23 ± 0.09	0.24 ± 0.09	<0.001*
Mean	0.33 ± 0.08	0.34 ± 0.12	0.32 ± 0.09	0.32 ± 0.08		
P-value	0.28 (therefore pairwise comparisons were not performed)					
* denotes significance P < .05						

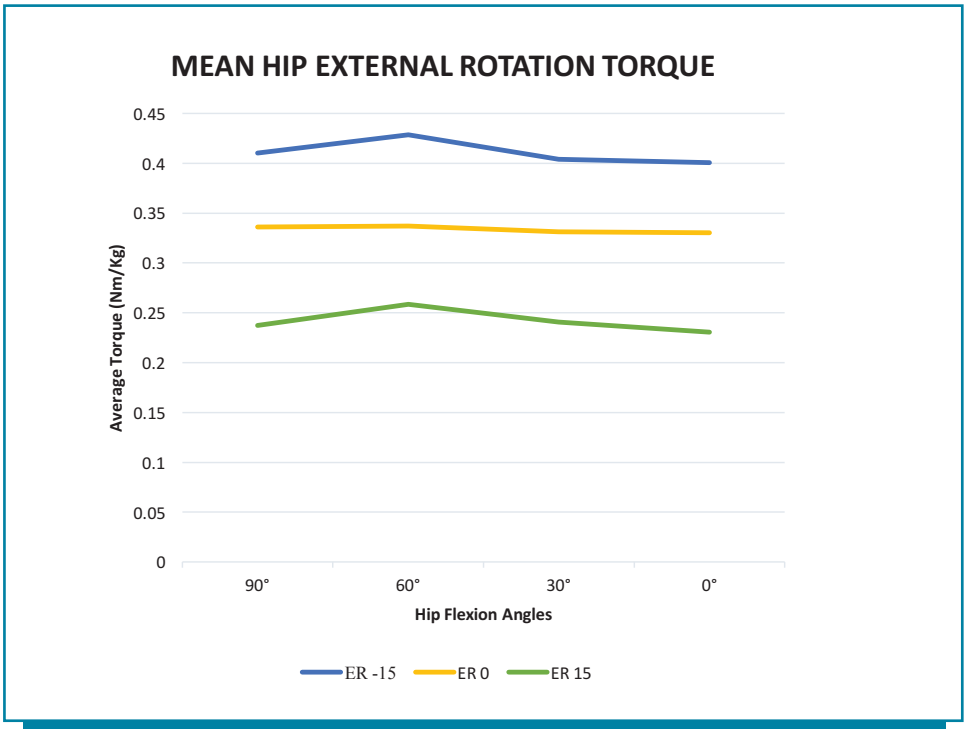

Figure 1. Mean hip external rotation torque.

ficult to perform. These exercises seem counterintuitive from a biomechanical perspective and may not be optimal. The hip external rotators, especially the gluteus maximus, should be strengthened in a manner that follows its normal strength curve to produce the best strengthening results biomechanically. This would mean that the greatest tension/resistance applied to the muscle should occur when the hip is in a slight internally rotated position and the least tension/resistance applied to the muscle when progressed into the ER ROM. This could be accomplished by changing the angle of the band. The current research study did not analyze the exercise methodology and could be investigated in another study. Additionally, this analysis is strictly biomechanical and does not measure the neuromuscular influences through electromyography (EMG). Further research is recommended to include the EMG component to the same biomechanical method.

Strengthening of the gluteus maximus, the strongest and most powerful hip external rotator according to Neumann,[6] has been recommended in numerous studies to help improve faulty kinematics of the lower extremity.[2,15] Since from a biomechanical perspective traditional Thera-Band exercises may not be efficient at strengthening the external rotators, the gluteus maximus can be strengthened in hip extension movements and can still result in an increase in overall hip ER strength. Hip extension exercises cause the gluteus maximus to contract, increasing the force producing capability of its ER component. This occurs because even though the gluteus maximus is also a strong hip extensor, the muscle cannot differentiate between movements; it simply develops tension. We hypothesize then that if we are strengthening the gluteus maximus (no matter if the exercise is going into hip ER or extension), then ultimately the hip's capacity to produce ER torque is being increased.

Hip Flexion and Hip External Rotation Torque

Unlike the research conclusions from studies performed by Bloom and Cornbleet,[7] Dostal et al,[9] and Simoneau et al,[10] we did not find a statistically significant difference between the angles of hip flexion and torque produced by the hip external rotators. It was concluded in those research studies that with increasing angles of hip flexion approaching 90°, that torque production of the hip external rotators would decrease because the angle of pull of the gluteus maximus would become disadvantaged.[7,9,10] However, our study does not support the conclusions of these previous studies as we did not find significant differences in strength across hip flexion angles. Simoneau et al[10] did report a high variability between the two hip positions in their study demonstrated that not all subjects are affected in the same manner by the change in hip flexion.[10] We propose the reason for no difference found in the current study is because some past studies were based soley on computer models and not actual subjects. Furthermore, other studies showed increased variability from subject to subject in the rotatory aspect of the hip.

Previous research done by Dostal et al[9] found that the hip external rotators should be strongest between 0° to 40° according to the line of pull of the muscles, especially gluteus maximus, and the length-tension relationship. Other studies which used EMG and moment arm analysis found that the gluteus maximus is minimally active when the hip is flexed and the external rotators produce more force near extension.[8,16] This research directed us to hypothesize that the hip external rotation musculature would produce the most torque when hip flexion angles were less than 40°. The results of this study caused the hip flexion aspect of our hypothesis to be rejected.

While much of the research analyzed prior to our data collection had results that were not supported by this research study, some studies also had similar results. One study found that 90° hip flexion resulted in the maximum hip external rotation torque because the deep external rotators (piriformis, obturator internus, gemellus superior, gemellus inferior, and quadratus femoris) were in a more optimal (ie, lengthened) position when in flexion. While the deep ER musculature was found to be at a better position at 90°, the gluteus maximus is in a disadvantaged position.[7,17] Another study found as hip flexion increases both internal and ER forces increase.[18] The results of our study implied a trend of the same results in that higher hip external rotator torque would be produced at 60° and 90° hip flexion, although statistical significance was not achieved.

Limitations

Several limitations must be noted that may have influenced the conclusion of this study. There was a small sample size of only 20 subjects and also a narrow age range between 20 and 25 years of age. The average age of 21 ± 2.1 years represents a young subject pool; therefore, the results cannot be applied to older subjects, and also subjects with pathology. It must also be noted that this study was evaluated from a mechanical perspective (torque) but not a neuromuscular perspective (EMG). Thus, it cannot be concluded nor speculated what degree of muscle activity occurs in the external rotators at each joint position.

CONCLUSION

Areas for Future Research

Future research should be conducted to examine the effects of strengthening the gluteus maximus, the strongest hip external rotator, using elastic bands compared to free weights. This research study also suggests more extensive research be performed to determine if manual muscle testing would be a more accurate assessment of strength if the muscles were positioned in a lengthened or neutral position, rather than a shortened position.

Clinical Applications

It is concluded that from this research study hip ER torque does not have a statistically significant difference related to hip flexion angle. It was determined that hip ER angle did produce a statistically significant difference on the production of hip ER torque, with the hip being positioned in -15° ER producing the greatest torque. It is advantageous to appreciate a muscle's strength at both its weakest and strongest points along the length-tension curve. It is vital to know where a muscle has its maximum and minimum force producing capacity as it assists the clinician in appropriately assessing the integrity of the muscle(s) in question (manual muscle testing) and when developing treatment programs for strengthening and rehabilitation. Further research should be done to investigate these conclusions.

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Finance Committee Report

Kimberly Wellborn, PT, MBA
Treasurer

The Finance Committee met August 24-25, 2017, to finalize a draft of the 2018 Orthopedic Section budget. This budget will be presented to the Board of Directors at their November face-to-face meeting. I want to thank the Finance Committee for their hard work and willingness to volunteer for this committee. The current members are Judith Hess, Penny Schulken, and Doug Bardugon.

The Orthopedic Section has many initiatives, ongoing and new, to enhance member benefits. Financing these initiatives appropriately is a high priority. As a result of our strong financial position, the Finance Committee made the following recommendations to the Board of Directors:

- Transfer $140,000 from the Section's checking account to the Research, Practice, and Education Endowment Fund in order to reach our goal of $3 million in this account 3 years earlier than planned. The original goal in our strategic plan was to reach $3 million by 2020. The Orthopedic Section is now in a position to fund initiatives that will enable our members to access research, practice, and education using the latest technological advances.
- Diversify our investments for Research, Practice, and Education to protect against any downturn in the market.
- Increase the amount of funds we need to keep in reserves. This is particularly important as the Orthopedic Section begins to embark upon new initiatives in which the cost has yet to be determined.

Please see the DeFlorian Report Summary below through July.

DeFlorian Report 2017

July

Income	Prior YTD Actual	Current YTD Actual	YTD Budget	Variance from Prior YTD	% Variance from PY	Variance from Budget
GOVERNANCE	$10,863	$0	$0	($10,863)	-100%	$0
INVESTMENTS	*N/A	$18,048	$102,851	*N/A	*N/A	($84,803)
OPERATIONS	$28,578	$30,941	$30,959	$2,363	8%	($18)
MEMBERSHIP	$439,671	$455,109	$460,833	$15,437	4%	($5,725)
EDUCATION	$567,893	$544,123	$311,395	($23,770)	-4%	$232,728
Annnual Meeting	$136,080	$102,642	$66,835	($33,438)	-25%	$35,807
CSM	$394,458	$418,901	$204,167	$24,443	6%	$214,735
CSM Pre-conferences	$36,755	$22,580	$40,393	($14,175)	-39%	($17,813)
JOURNALS/NEWSLETTERS	$80,020	$61,088	$60,171	($18,932)	-24%	$917
INDEPENDENT STUDY COURSES	$168,901	$203,356	$227,188	$34,455	20%	($23,832)
TOTAL INCOME:	**$1,296,129**	**$1,312,666**	**$1,193,397**	**$16,537**	**1%**	**$119,268**

Expenses	Prior YTD Actual	Current YTD Actual	YTD Budget	Variance from Prior YTD	% Variance from PY	Variance from Budget
GOVERNANCE	$161,920	$196,293	$175,466	$34,374	21%	$20,827
INVESTMENTS	*N/A	$26,560	$22,167	*N/A	*N/A	$4,393
OPERATIONS	$386,062	$428,063	$413,487	$42,001	11%	$14,576
MEMBERSHIP	$256,664	$172,441	$174,229	($84,223)	-33%	($1,789)
EDUCATION	$158,857	$136,394	$119,706	($22,463)	-14%	$16,688
Annnual Meeting	$125,898	$108,234	$84,216	($17,664)	-14%	$24,018
CSM	$22,803	$19,888	$23,788	($2,914)	-13%	($3,900)
CSM Pre-conferences	$9,936	$7,873	$11,702	($2,064)	-21%	($3,829)
JOURNALS/NEWSLETTERS	$80,520	$75,577	$89,531	($4,944)	-6%	($13,955)
RESEARCH	*N/A	$109,999	$89,060	*N/A	*N/A	$20,938
PRACTICE	*N/A	$12,860	$19,583	*N/A	*N/A	($6,723)
INDEPENDENT STUDY COURSES	$92,255	$49,753	$78,253	($42,502)	-46%	($28,500)
PUBLIC RELATIONS	*N/A	$38,370	$11,028	*N/A	*N/A	$27,343
AWARDS	*N/A	$5,031	$4,422	*N/A	*N/A	$609
NOMINATING COMMITTEE	$45	$38	$700	($7)	-16%	($662)
OCCUPATIONAL HEALTH SIG	$679	$1,368	$1,458	$689	102%	($90)
FOOT AND ANKLE SIG	$7,538	$8,053	$1,458	$515	7%	$6,595
PAIN MANAGEMENT SIG	$19	$86	$1,458	$67	356%	($1,373)
PERFORMING ARTS SIG	$15,007	$6,248	$1,458	($8,758)	-58%	$4,790
ANIMAL REHABILITATION SIG	$388	$979	$1,458	$591	153%	($479)
IMAGING SIG	$2,435	$33	$1,458	($2,403)	-99%	($1,426)
TOTAL EXPENSES	**$1,162,388**	**$1,268,145**	**$1,206,381**	**$105,757**	**9%**	**$61,764**

TOTAL INCOME	$1,296,129	$1,312,666
TOTAL EXPENSES	$1,162,388	$1,268,145
TOTAL PROFIT(LOSS)	$133,740	$44,520

SIG Encumbered Funds	YTD
OCCUPATIONAL HEALTH SIG	$ 20,744
FOOT AND ANKLE SIG	$ 41,073
PAIN MANAGEMENT SIG	$ 3,045
PERFORMING ARTS SIG	$ 576
ANIMAL REHABILITATION SIG	$ 18,908
IMAGING SIG	$ 4,985

Investments-Monthly Update			
Investment	**2017**	**Dec-16**	**Dec-15**
LPL Reserve Fund	$ 1,365,918	$ 1,232,954	$ 1,231,557
LPL CD's	$ 260,420	$ 259,597	$ 258,458
LPL Bulding Fund	$ 395,872	$ 363,916	$ 360,268
Wells Fargo Advisors	$ 2,860,727	$ 2,591,267	$ 2,508,927
Total Investments	**$ 4,882,937**	**$ 4,447,734**	**$ 4,359,210**
Cash Accounts	$ 422,208	$ 366,288	$ 115,846

***NOTES - In 2016 Investments were part of the Governance Budget. Therefore, there are no prior year numbers to compare to. This also applies to Research, Practice, Public Relations and Awards since they were part of the Membership Budget.**

Wooden Book Reviews

Rita Shapiro, PT, MA, DPT
Book Review Editor

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

Fundamentals of the Physical Therapy Examination: Patient Interview and Tests and Measures, 2nd Edition, Jones & Bartlett Learning, 2018, $99.95
ISBN: 9781284099621, 436 pages, Spiral Cover

Author: Fruth, Stacie J., PT, DHSc, OCS

Description: This is a second edition of a book detailing the physical therapy examination. The online content, available for a year after redeeming the access code, includes the complete ebook with embedded knowledge checks and videos. The first edition was published in 2014. **Purpose:** The author states that the purpose is to "provide novice to intermediate students of physical therapy with a resource that can be used both in the classroom and clinic to help them learn methods of collecting meaningful verbal, observational and measured data from any patient, regardless of setting or diagnosis. It is also designed as a resource for physical therapy faculty." This book meets its purpose in every way. It is a tool that is comprehensive but made for the clinical world. Both the online and print versions are true assets for teaching this subject. **Audience:** The intended audience is student physical therapists as well as novice clinicians. Physical therapy students who might need help or review during their clinical rotations would specifically benefit from this book as well. The author is founding chair, professor, and director of the Doctor of Physical Therapy program at Western Michigan University. She has been teaching in this area since 2003 and obtained her Orthopaedics Clinical Specialist certification in 2011. **Features:** The book starts with a comprehensive presentation of the patient interview. The author details the various components, but also adds pearls of wisdom. For example, the author reminds students to learn from every patient and notes the rewards of impacting patients' lives and the "the unexpected gift" of patients impacting a therapist's life. The second part of the book is dedicated to the different tests and measures used in a physical exam. One of the unique aspects of the book is the discussion of determining when a test/exam is a priority or pointless and why. The section on communication has wonderful quotes about listening, service, etc. **Assessment:** This book and the accompanying online resources are a welcome addition to the education of new physical therapists in the performance of all aspects of an examination. They go beyond presenting a collection of special tests and keep the clinical reasoning underlying the examination process at the forefront. This book is appropriate across various practice settings (i.e. acute, home health, outpatient). A particular strength is the section pertaining to communication, which is especially poignant and insightful.

Jeff B. Yaver, PT
Kaiser Permanente

Orthopedic Clinical Examination, Human Kinetics, 2016, $129
ISBN: 9781450459945, 1152 pages, Hard Cover

Editor: Reiman, Michael P., PT, DPT, OCS, SCS, ATC, FAAOMPT, CSCS

Description: This is an excellent, comprehensive, evidence-based, orthopedic musculoskeletal clinical examination book. It provides more depth and breadth than any current orthopedic clinical examination books and is well organized and easy to follow. The accompanying online videos are detailed and easy to follow. **Purpose:** The purpose is to provide readers with the knowledge and skills needed to approach the examination process. Each chapter on examination is presented consistently using a broad-to-focused format. The author states that this style of writing ensures "repetition and improved consistency in learning." The book accomplishes its goal, and the videos enhance the detail that is presented in the book. **Audience:** The intended audience includes physical therapy and athletic training students, medical students, and any clinicians who want a systematic approach to musculoskeletal examination. Specifically, it is recommended for medical students and graduate students enrolled in orthopedic, physical therapy, and athletic training programs. The book also can serve as a reference for certified athletic trainers, physical therapists, physicians, and physician assistants. The contributors are all credible authorities in their subject areas. **Features:** The book covers anatomy systems, concepts and principles of examination, examination of the head and spine, examination of the extremities and examination of special populations. The review of systems is very detailed and serves as a knowledge base for the rest of the book. The client interview and differential diagnosis sections are excellent. The special test section, however, could have been more detailed. The pictures and video demonstrations are well done and easy to understand and follow. Unique to this book is the web resource guide which has case study reviews, interactive questions, videos, and links to abstracts. **Assessment:** This is an excellent and detailed guide to the orthopedic clinical examination. It is well written and comprehensive. There are many other orthopedic examination books available, but the strength of this one is the detailed coverage of each topic. The supplemental web resources with case studies and videos make it unique.

David M. Nissenbaum, MPT, MA, LAT, OCS, PES

OCCUPATIONAL HEALTH

The Occupational Health Special Interest Group authored and adopted clinically oriented guidelines in 2011 with the purpose of defining and guiding individuals in this area of specialty practice. These can be found on the OHSIG webpage in the Orthopaedic Section website, www.orthopt.org. Without considering themselves as practicing in the area of occupational health, most physical therapists will provide services to individuals with work limiting conditions or the potential of such conditions. These documents aim to serve as a reference for all physical therapists, whether entry level or occupational health specialist. Currently, experts in each area are updating these documents to reflect current, evidence-based practice. Topics including the evaluation of functional capacity, prevention, and ergonomics are anticipated to be completed by February 2018. The remaining documents are available for reference on the OHSIG web page including management of the acutely injured worker, legal and risk management, and advanced work rehabilitation.

A summary of the activities that define the practice of physical therapists in the context of work is in the document titled, *Physical Therapist in Occupational Health*. It is printed here for your critical review. As you read the information below, ask the following questions: Is the information relevant to current practice? Is it a complete listing of activities? Does this represent appropriate entry level knowledge? More specifically, does "back school" still have a place in occupational health practice? What about prevention and wellness initiatives in the context of promoting population health?

Direct comments to any member of the leadership team. You may also add to the discussion on the closed Facebook page, Occupational Health SIG. Plan now to attend 2018 Combined Sections Meeting with a change in the OHSIG Membership Meeting format, allowing for a more robust discussion and exchange of ideas.

PHYSICAL THERAPIST IN OCCUPATIONAL HEALTH

Adopted by the Orthopaedic Section BOD July 11, 2011

The role of the physical therapist in occupational health includes examination and evaluation of individuals with work-related risk factor(s), impairments, activity limitations, participation restrictions, or other health-related conditions which prevent individuals from performing their occupational pursuits to determine a diagnosis, prognosis, and implement intervention as necessary. The examination includes the history, systems review, and tests and measures. The tests and measures include:

- aerobic capacity/endurance
- anthropometric characteristics
- arousal, attention, and cognition
- assistive and adaptive devices
- circulation (arterial, venous, lymphatic)
- cranial and peripheral nerve integrity
- environmental, home, and work (job/school/play) barriers
- ergonomics and body mechanics
- gait, locomotion, and balance
- integumentary integrity
- joint integrity and mobility
- motor function (motor control and motor learning)
- muscle performance (including strength, power, and endurance)
- neuromotor development and sensory integration
- orthotic, protective, and supportive devices
- pain
- posture
- prosthetic requirements
- range of motion (including muscle length)
- reflex integrity
- self-care and home management (including activities of daily living and instrumental activities of daily living)
- sensory integrity
- ventilation and respiration/gas exchange
- work (job/school/play), community and leisure integration or reintegration (including instrumental activities of daily living)

The physical therapist in occupational health evaluates the data from the tests and measures to determine the diagnosis and prognosis, and to determine the interventions that will be utilized to alleviate the work-related risk factors, impairments, activity limitations, participation restrictions, or other health-related conditions which prevent an individual from performing their occupational pursuits. In addition, the physical therapist in occupational health also provides appropriate interventions for non-work related injuries that prevent individuals from performing work-related tasks.

Whenever possible, interventions should be based on evidence supporting their use. All interventions necessitate coordination, communication, and documentation to ensure that the patient/client receives appropriate and cost-effective services. Patient/client related instruction imparts information and develops skills to promote work independence. Procedural interventions include:

- therapeutic exercise to increase the worker's capacity to execute physical tasks required for work activities
  - aerobic capacity/endurance conditioning or reconditioning
  - balance, coordination, and agility training
  - body mechanics and postural stabilization
  - flexibility exercises
  - gait and locomotion training
  - neuromotor development training
  - relaxation
  - strength, power, and endurance training for head, neck, limb, pelvic-floor, trunk, and ventilatory

- functional training in work (job/school/play), community and leisure integration or reintegration which includes a broad group of activities designed to integrate or to return the patient/client to work as quickly and as efficiently as possible, and which involves improving a patient's/client's physiologic capacities to facilitate the fulfillment of work-related roles using any of the following modes of intervention:
  - barrier accommodations or modifications
  - environmental or work task adaptation

- ergonomic stressor reduction
- device and equipment use and training
- assistive and adaptive device or equipment training during IADL
- orthotic, protective, or supportive device or equipment training during IADL
- prosthetic device or equipment training during IADL functional training programs
- back schools
- job coaching
- simulated environments and tasks
- task adaptation
- task training
- travel training
- work conditioning
- work hardening programs
- injury prevention or reduction
- injury prevention education during work integration or reintegration
- injury prevention education with use of devices and equipment
- safety awareness training during work

- manual therapy techniques (including mobilization/manipulation)
- prescription, application, and, as appropriate, fabrication of devices and equipment (assistive, adaptive, orthotic, protective, supportive, and prosthetic)
- integumentary repair and protection techniques
- electrotherapeutic modalities
- physical agents and mechanical modalities.

Services rendered by the physical therapist in occupational health may be delivered in hospitals, homes, outpatient clinics or offices, rehabilitation facilities, subacute care facilities, corporate or industrial health centers, industrial, workplace or other occupational environments, fitness centers, and education or research centers.

Physical therapists in occupational health also participate in prevention and the promotion of health, wellness, and fitness, consultation, and education.

Integration of prevention, and the promotion of health, wellness, and fitness into the practice of the physical therapist in occupational health may be accomplished through the following activities:

- analyzing work tasks, tools and work station design
- redesigning workplace, work task, or work station
- matching of work tasks, tools and work station design to the worker
- providing exercises and postural training to prevent job-related disabilities

Consultation occurs when the physical therapist in occupational health renders professional or expert opinion or advice. They apply their highly specialized knowledge and skills to identify problems in the workplace, to recommend solutions to those problems, and to produce a safe, injury-free, ergonomically sound work environment on behalf of the patient/client. Such consultation may include:

- advising employers about the requirements of the Americans with Disabilities Act (ADA) and how to make reasonable accommodations
- advising employers about the requirements of OSHA and worker's compensation
- conducting a program to determine the suitability of employees for specific job assignments
- developing programs that evaluate the effectiveness of an intervention plan in reducing work related injuries
- instructing employers about pre-placement in accordance with provisions of the ADA
- developing functionally based job tasks descriptions
- providing expert testimony and record review
- working with the employees, labor unions, and government agencies to develop injury reduction and safety programs.

Screening is the brief process to determine the need for further examination or consultation by a physical therapist, or for referral to another health professional. Examples of screening activities in which physical therapists in occupational health engage include the following:

- identifying risk factors in the workplace
- pre-performance testing of individuals in the work place
- testing of individuals post-work.

Education is the process of imparting information or skills and instructing by precept, example, and experience so that individuals acquire knowledge, master skills, or develop competence. In addition to instructing patients/clients as an element of intervention, physical therapists in occupational health may engage in the following educational activities:

- planning and conducting programs for the public to increase their awareness of work-related injuries
- planning and conducting education programs for local, state and federal health agencies concerning the importance of work site safety
- conducting education programs for employees and management about the importance of workplace safety and injury prevention.

Physical therapists in occupational health also are involved in the provision of peer review and utilization review services.

Physical therapists in occupational health coordinate their service delivery activities with other health care professionals, employees, employers, insurers, governmental regulatory and administrative agencies, and others involved in assuring that the optimum work environment exists for the prevention of injury and for the rehabilitation of work-related impairment, activity limitation, and participation restrictions.

President's Letter

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

Fall marks the beginning of new endeavors for the Performing Arts SIG.

Many of us are presenting at the upcoming International Association for Dance Medicine & Science 27th Annual Conference on October 12-15, 2017 in Houston, Texas. Over the 4-day conference, PASIG members and leaders are presenting didactic sessions, interactive workshops, movement sessions, round table discussions, networking events, debates, poster presentations, and more. We look forward to the evidence-based duels on the dancer as artist vs athlete, cryotherapy pro vs con, and dancer screening pro vs con, as Annette, Rosie, and Laurel battle it out with other IADMS folks! We look forward to seeing you there! Please stop by our PASIG-Orthopaedic Section booth, as we are now proud sponsors of IADMS.

The PASIG is awarding student scholarships at both IADMS and CSM. If you are a student and have been accepted to present a poster or platform at either IADMS or CSM 2018, please contact us immediately and submit your abstract. We will provide a blinded peer-review and choose a scholarship recipient for each conference.

IADMS student presenters, contact me at akarim@apu.edu

CSM 2018 student presenters, if your performing arts poster or platform is accepted, please apply for the PASIG student scholarship. Contact Anna Saunders: annarosemary@gmail.com

The APTA Combined Sections Meeting will be held February 21-24, 2018, in New Orleans, Louisiana. Many of our members will also be presenting at CSM. Stay tuned for information on the PASIG main session! We look forward to providing the latest evidence in performing arts research and practice. When you receive confirmation of your platform, poster, or session presentation, please let us know so we can spread the word to the PASIG membership! Contact Rosie Canizares: Rcc4@duke.edu

In terms of our ongoing efforts, the PASIG is working on the following:

Mentorship: We have provided and intend to continue to provide mentors to 3rd year student Orthopaedic Section members who are interested in clinical practice and research in the performing arts and orthopaedics. If you are interested in being a mentor, please contact Megan Poll, who not only serves as PASIG Secretary, but as the coordinator for the 6-month Orthopaedic Section mentorship program: meganpoll@gmail.com

For students interested in becoming a mentee, contact Megan for the upcoming round of applications. Last year's application can be viewed for applicant criteria:

https://www.orthopt.org/downloads/Ortho_Mentorship_application_2015.pdf

Clinical Sites: We are currently updating the list of clinical rotation sites on our website. Please email Rosie Canizares if you take students and would like your information included on this list: Rcc4@duke.edu

Membership: We are also trying to keep our membership connected. Please email Liz Chesarek if you are a new member, or want to become more involved as a current member: echesarek@gmail.com. We would like to know your interests, and maintain information to pass on such as if you can provide backstage PT, if you treat a specific performing arts population, etc. Membership is free to all Orthopaedic Section members.

Member involvement: The PASIG leadership will transition again at CSM. We will be voting on a new Nominating Committee member via the Orthopaedic Section, and appointing chair positions. One way to get involved in our leadership is by being part of a committee. Please contact the Nominating Committee Chair if you are interested in serving in a particular area. Students are welcome!

Dancer Screening: For getting connected to others involved in dancer screening, please contact Mandy Blackmon: mandydancept@gmail.com

Social Media: To belong to our Facebook page, contact Dawn (Muci) Doran, and please tweet about performing arts with us @pt4performers

Fellowship: The practice analysis re-validation project team is working on final revisions for the upcoming publication of the Description of Fellowship Practice (DFP) for Performing Arts Physical Therapy. The Description of Advanced Specialized Practice (DASP) in Performing Arts Physical Therapy was approved by the ABPTRFE in January 2016. The DFP is currently being reviewed by ABPTRFE. This is the final phase for laying the groundwork for providing current practice guidelines in the subspecialty area as well as curriculum requirements for Performing Arts PT Fellowships.

Citation Blasts: If you have a topic of interest and would like to contribute to the monthly e-blast, contact Laura Reising: lbreising@gmail.com.

OPTP Submission: If you have a brief, clinically-focused case report on a performing arts PT patient or a clinical commentary, please contact me to submit your writing: akarim@apu.edu

I would like to thank our Nominating Committee member and former Research Chair, Brooke Winder for sharing her case report on a dancer with pelvic floor dysfunction and use of dynamic neuromuscular stabilization as an intervention.

Pelvic Floor Dysfunction in a Dancer with Lumbar, Sacroiliac, and Coccyx Pain: A Case Report

Brooke Winder, PT, DPT, OCS
California State University, Long Beach
Sarton Physical Therapy

This report describes the case of a professional dancer who quit performing after developing chronic right sided lower lumbar, sacroiliac, and coccyx pain. The goal of this report is to highlight the

need to consider and treat pelvic floor dysfunction in dancers with pain located in the spine, sacroiliac joint, and related areas. It also highlights the integration of dynamic neuromuscular stabilization (DNS) exercise techniques to optimize intra-abdominal pressure regulation and improve muscle activation patterns in a patient case involving both orthopedic and pelvic floor dysfunction.

INITIAL PRESENTATION

The patient was a 26-year old female dancer who presented to the clinic with chief complaint of daily right-sided lower lumbar and sacroiliac joint pain, with intermittent coccyx pain, for more than a year. Her onset of pain was gradual after having danced professionally as an aerialist in a show for a one-year period. She notes that while in this show she spent hundreds of hours training and performing in a 2-point harness while wearing a mermaid-tail costume that kept her hips in a position of adduction. Patient reports previous treatment had involved physical therapy, chiropractic manipulations, acupuncture, Rolfing, craniosacral therapy, and wearing a sacroiliac belt. She notes most interventions gave her temporary relief but her symptoms would quickly return. Wearing a sacroiliac belt had increased her pain. She denied radiating pain, numbness, weakness or tingling into the lower extremities, bladder/bowel frequency, urgency, or leakage. She did report abdominal cramping during her menstrual cycle that exacerbated her back and sacroiliac joint pain. Other medical history was insignificant. Patient's primary goal was to return to daily activities without restriction. Patient also reported a desire to return to dancing recreationally. Oswestry Disability Index Score[1] was 50%, and pain was rated at 5/10 on the Numeric Pain Rating Scale.[2]

Initial Functional Limitations:
Unable to stand > 20-30 minutes
Unable to walk > 1-2 minutes
Unable to squat, lift, or bend without pain
Unable to participate in exercise
Quit work as a professional dancer due to long standing pain

Initial Evaluation: Objective Examination:

Posture: Scapular abduction B with posterior shift of thorax, pelvic obliquity significant for left posterior innominate/right anterior innominate rotation, mild genu recurvatum

Gait: Posterior shift of thorax throughout, (+) Trendelenberg B with excessive lumbopelvic hip rotation B (L > R)

Seated diaphragm test:[3] Decreased lateral excursion of lower ribs on R > L side

Lumbar Active ROM:

Flexion: Fingertips to lower shin with "catch" in first 20% of the movement with lateral shift to the left, painful arc upon return

Extension: Immediate increase in pain with initiation of the movement

Left lateral flexion: Fingertips to left knee joint

Right lateral flexion: Fingertips 3" above knee joint with R sided pain

Hip Active ROM/Passive ROM: Mild stiffness into end range passive right hip internal rotation

Standing March Test: Unstable and painful with right side weight bearing, excessive left hip hike and left pelvic rotation

Seated March Test: Mild right lumbopelvic rotation with right hip flexion, significant left lumbopelvic rotation with left hip flexion

Active Prone Knee Flexion Test: Early anterior pelvic tilt and contralateral pelvic rotation B

Intra-abdominal Pressure Test in Supine:[3] Inferior movement of umbilicus, hollowing in regions of L > R internal and external obliques, left rib flare. Fatigue with 10-second hold

Active Straight Leg Raise:[4] (+) Left

Manual Muscle Test Gluteus Medius: R 3+/5, L 4/5 (substitutes with quadratus lumborum B)

Manual Muscle Test Gluteus Maximus: R 4/5, L 4-/5 (hamstring dominant pattern on left)

**Poor multifidus activation on right lower lumbar in quadruped with attempt at lower extremity extension

Palpation:

Myofascial restrictions and tender to palpation (TTP)along lower lumbar paraspinals, right quadratus lumborum, right superior-lateral gluteals and bilateral deep hip rotators. Palpable hypertonicity right adductors > left side. Connective tissue restrictions along abdominal wall and TTP with hypertone along upper rectus abdominis. Tender to palpation along right sacroiliac joint.

Posterior-anterior pressure to right L5: Painful

Unilateral posterior-anterior pressure right sacral base: Painful, hypomobile

Coccyx in excessive flexion and mild right deviation

Pelvic Floor Evaluation:

Visual observation: Elevated perineum

Pelvic floor strength: 4+/5, fatigue after 5-second hold, with delayed relaxation post contraction

Pelvic floor transvaginal muscle palpation[5]**:** Moderate hypertonicity and TTP right pubococcygeus, R > L iliococcygeus, R > L coccygeus (referred pain to coccyx and sacroiliac joint region) and R obturator internus.

ASSESSMENT AND CLINICAL REASONING

Patient demonstrated movement dysfunction consistent with lumbar extension-rotation syndrome due to poor control and strength of her obliques, multifidus, and gluteus medius and maximus. Poor control of intra-abdominal pressure regulation and limited lumbopelvic stability combined with pelvic floor hypertonicity exacerbated the overload to the lower lumbar and sacrococcygeal joints. This dancer also demonstrated pelvic floor tender points and myofascial restrictions that reproduced sacroiliac and coccyx region pain.

Dancers are at risk for pelvic floor dysfunction, though pelvic floor problems in dancers and other athletes often go underreported.[6,7] Shortened, hypertonic, or overactive pelvic floor muscles not only produce pelvic pain but can refer pain to the lumbar spine, sacroiliac region, hip, and abdominal wall.[8,9] Female dancers commonly present with risk factors for pelvic floor dysfunction, including participation in repetitive impact activities (jumping and leaping), dysmenorrhea, nutrient deficiency,[10] scoliosis,[11] and lumbopelvic and hip injuries.[12–15] Dancers can commonly train with chronic holding patterns including overactive abdominals, gripping or posteriorly tilting in the pelvis, and use the deep outward rotators (of these, the obturator internus has a direct anatomical relationship with the pelvic floor[13]) and adductors consistently to maintain turnout. In this dancer's case, long-term training and performance in the two-point harness likely contributed to chronic pelvic floor and adductor holding patterns, pelvic obliquity, and inhibition of the gluteals. Patients previous treatments had not addressed any pelvic floor dysfunction, and had failed to signifi-

cantly address movement retraining and stabilization. Reports of menstrual cycles consistently exacerbating her back and sacroiliac pain as well as reports of coccyx region pain led this clinician to suspect pelvic floor muscle involvement.

INTERVENTION

Twelve sessions of physical therapy over a 3.5-month period with a large focus on home exercise program.

Manual Therapy

Treatment goals for this patient included reduction of connective tissue restrictions to offload the pelvic floor[16,17] and lumbopelvic region, reducing pelvic floor tender points and hypertonicity, decreasing restrictions along the quadratus lumborum and deep hip rotators to reduce joint compression, and improve sacrococcygeal joint symmetry and mobility. Manual techniques included skin rolling and myofascial release to the abdominal wall and inner thighs, soft tissue mobilization to the deep hip rotators with passive ROM of the hips, and post-isometric relaxation to the right quadratus lumborum. Grade I-IV unilateral PAs were performed on the right sacral base. After myofascial release of the pelvic floor musculature, the coccyx pain resolved (within 2 sessions) and coccyx position was improved. Manual therapy interventions were focused primarily in the initial sessions and subsequent sessions focused on movement re-education and exercise training.

****Associated home program:** Skin rolling abdominals and inner thighs, myofascial release to deep hip rotators, progression to self-trigger point release of pelvic floor muscles with crystal wand.

Exercise and Movement Retraining

Treatment focus for this patient began with improving breathing mechanics and intra-abdominal pressure regulation. Instruction in diaphragmatic breathing with visual cueing to encourage pelvic floor relaxation was the first step to decrease rectus abdominis and pelvic floor holding patterns and improve pelvic floor excursion. Then, the patient was cued in the supine 90-90 developmental position commonly used in DNS training, using a figure-8 theraband wrap to facilitate optimal spinal posture and hip joint centration, inhibit pelvic floor gripping, and encourage improved abdominal oblique muscle activation. Once proper IAP regulation was achieved in this position, the patient was progressed to movements of the arms and limbs against the wrap from this position as well as rolling side to side to challenge sagittal and transverse plane stability.[3]

To continue to address lumbar spine extension-rotation syndrome, the patient was trained with tactile and verbal feedback in supine bent knee fall outs (eventually adding theraband resistance), active prone knee flexion, and seated marches to improve trunk stability and lumbopelvic hip dissociation.

Quadruped developmental DNS positions were used to facilitate proper trunk control for squatting movements and to facilitate improved activation of multifidus and the hip extensors with the addition of lower extremity extensions and crawling. Theraband wrapping in a figure-8 was also used in this position to increase muscle activation. The patient was progressed to rolling and side-propped developmental positions to facilitate lateral muscle stability and gluteus medius activation.

Once more adequate muscle activation patterns were present in the DNS positions, the patient was progressed to increased resistance, more traditional gluteal strength exercises (hip abduction, clams, lateral stepping, bridging series, squats) with incorporation of proper intra-abdominal pressure regulation and trunk control. As the patient developed decreased symptoms she added a goal of wanting to participate in Pilates classes, and she was trained in basic leg press and abdominal stabilization on the reformer as well as in self-cueing to decrease over-activation of the pelvic floor during these exercises.

****Associated home exercise program:** Home program mimicked the exercises and progressions as noted above.

Patient presentation at the end of 12 sessions:

Pain levels on National Pain Rating Scale: 2/10 at worst in low back and sacroiliac, now intermittent vs. constant, and 0/10 coccyx pain.

Oswestry Disability Index Score: 16%

- Able to stand 45 minutes to 1 hour.
- Able to walk 25-30 minutes.
- Able to perform light squatting, and able to lift a flat of water bottles.
- Initiated Pilates training on the reformer without exacerbation of pain.
- Not yet returned to dancing recreationally.*
  - * At this point, physical therapy was paused due to financial limitations with the goal of returning to physical therapy to progress toward recreational dance training.

CONCLUSION

Dancers who present with lumbar spine and sacrococcygeal symptoms should be screened for possible associated pelvic floor dysfunction. Interventions to address pelvic floor dysfunction and movement retraining focused on improving intra-abdominal pressure regulation were important aspects in restoring function. Orthopaedic exercise interventions to improve lumbar spine stabilization often inherently facilitate pelvic floor activation; clinicians should be aware that some dancers may present with hypertonic or shortened pelvic floor muscles leading to exacerbation of their pain, and may instead need a focus on pelvic floor muscle down training.

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OPTSIG ORTHOPAEDIC SECTION, APTA

PERFORMING ARTS **LEADERSHIP**

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Megan Poll, Secretary	2017-2019	meganpoll@gmail.com

Greetings and welcome to Fall from the Foot and Ankle SIG.

We provided a lengthy update on FASIG activities in the last issue of *Orthopaedic Physical Therapy Practice* so this time we wanted to return to some "foot and ankle" practice content for our membership. But, as a quick update we are happy to report the FASIG Facebook page is off to a great start with frequent posts and lots of great clinical pearls to share. Join the page to stay connected (https://www.facebook.com/groups/FASIG). There is new information on strengthening the intrinsic muscles of the foot that might be helpful in treating your patients. The following article on Big Toe Stiffness was submitted by the FASIG Practice Committee.

Big Toe Stiffness

There is never a bad time to discuss stiffness in the big toe, otherwise known as hallux limitus or hallux rigidus. For this article, let's examine the implications to movement of hallux stiffness and whether it is *primary* or *secondary*. While podiatrists and orthopedists may define rigidus and limitus a bit differently, we do know one thing for certain: loss of motion at the first metatarsophalangeal (MTP) joint is worth assessing. A definition of this condition will first be presented and then several dysfunctions that accompany big toe stiffness will be discussed.

Hallux rigidus is considered by many podiatrists to be the end stage of hallux limitus, or a state in which your ability to create motion in your big toe is lost or severely restricted. Hallux rigidus may lead to long-term damage of your first MTP joint, and usually involves erosion of the joint cartilage and the development of osteoarthritis, or degenerative joint disease. Hallux rigidus is a condition characterized by near-ankylosis, or a state in which the big toe becomes stiff and immobile due to the partial fusion of your involved bones.

Hallux limitus is a bit more intriguing, because it can manifest for a wide variety of reasons. The symptoms of hallux limitus are:

- pain, especially during weight-bearing movements, but possibly constant and appearing while the foot is at rest or after the shoe has been removed;
- grinding or grating feeling on top of the joint with activity and walking;
- development of bone spur, dorsally;
- some stiffness and limited motion of the hallux;
- increased pain and stiffness in cold temperatures;
- difficulty wearing shoes, especially high heels, due to increased pressure on the joint;
- difficulty wearing flexible shoes, flip flops, or shoes with poor support;
- feeling of tightness in and around the joint;
- swelling and inflammation of the joint, especially on the top; and
- pain in other parts of your body due to the change in your gait.

Primary Big Toe Stiffness

Sometimes, limitus is a function of foot and toe function exclusively. For example, hallux valgus can, as the condition progresses, result in big toe stiffness, along with bunions, sesamoid malalignment, etc. In this case, the limitus is primary and can force patients to compensate their gait pattern. This phenomenon is very apparent with bunionectomy patients, for example. Postoperative immobilization allows the first MTP to stiffen and the patient ambulates to compensate for limited motion, often times by moving propulsion and weight bearing more laterally on the foot. The treating therapist promotes mobilization at the MTP, restores range of motion, and instructs weight bearing more medially on the foot. Proximal kinetic chain compensations, such as hip abductor weakness, should also be assessed. A *primary* stiff toe condition can have dramatic effects on proximal structures.

Secondary Big Toe Stiffness

Can pre-existing proximal structure dysfunctions have an effect on the big toe? Yes! We know this is true, using the example above, because patients with weak hip abductors will exaggerate lateral sway and move weight bearing laterally at the foot. Over time, the big toe undergoes stiffness because of underuse, the great toe is avoided for propulsion (90° of dorsiflexion is no longer needed), so the joint stiffens.

Case Study

Here is another interesting example of *acquired* hallux limitus. We recently had a patient undergo proximal and distal patellofemoral realignment. This 45-year-old woman had experienced giving way episodes due to uncontrollable lateral patellar subluxation since age 20. A significant amount of quadriceps atrophy and movement apprehension was noted postoperatively. At her examination, she was surprised when we assessed big toe range of motion, asking, "Why would you look at my foot?" Upon examination, she had 30° of motion at the MTP and had adopted a gait pattern that included cupping of the foot, fifth ray weight bearing, and absent knee flexion. Because of years of compensated walking, motion at the MTP was limited (limitus).

Hallux limitus is intriguing because the sources of stiffness are not limited to the MTP articulation and the arthritic process. Sources of limitus can be:

- plantar fascia tightness,
- dorsal/plantar ligament/capsule stiffness,
- sesamoid hypomobility,
- passive insufficiency of short toe flexors (flexor hallicus brevis and foot intrinsics), or
- passive insufficiency of long toe flexors (flexor hallicus longus).

The experienced orthopaedic physical therapist is never surprised by the ways patients can compensate movement patterns and function. The impact of these compensations often results in further impairment. Therefore, addressing stiffness at the big toe is essential in understanding ALL lower extremity conditions. Many treatment choices are available to restore MTP motion, (stretching, mobilization, etc.) so let's not forget to include the foot, the ankle, and the great toe as a prerequisite evaluation site for all of our lower extremity patients.

CPG UPDATES

JUST PUBLISHED: Neck Pain (Revision)
*Check out the new decision making model and recommendations

Keep an Eye out for these ICF Based Clinical Practice Guidelines publishing soon in JOSPT:
- Knee Stability and Movement Coordination Impairments: Knee Ligament Sprain (Revision)
- Achilles Pain, Stiffness, and Muscle Power Deficits: Achilles Tendinitis (Revision)

Drafts ready soon for external review: We want your feedback!
- Work Rehabilitation and Physical Therapist Practice (New)
- Knee Pain and Mobility Impairments: Meniscal and Articular Cartilage Lesions (Revision)
- Exercise-based Knee injury Prevention (New)

Great Resources for clinicians and patients found here:
http://www.orthopt.org/content/practice/clinical-practice-guidelines

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Description

This monograph series introduces the reader to the emerging fields of regenerative medicine and sensor technologies and their role in advancing orthopaedic rehabilitation. Experts in each of these areas share their insight on what the future holds and how it can impact physical therapy practice and rehabilitation. A review of the biology underlying tissue injury and repair are covered along with the role stem cell therapy can provide. Specific technology applications are provided for telehealth and virtual reality.

Topics and Authors

The Science of Neuromuscular Healing
Andrew Piraino, PT, DPT, OCS, CSCS
Interfacing Engineering Technology and Rehabilitation: A New Frontier for Physical Therapy
Randy Trumbower, PT, PhD; Denise M. Peters, PT, PhD; Steven L. Wolf, PT, PhD, FAPTA
Regenerative Medicine
Nana Takenaka-Niganawa, PT, PhD; Akira Ito, PT, PhD; Tomoki Aoyama, MD, PhD
Telehealth and Virtual Reality in Musculoskeletal Practice
Alan C. Lee, PT, PhD, DPT, CWS; Judith Deutsch, PT, PhD, FAPTA

Continuing Education Credit

Fifteen 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.

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PAIN MANAGEMENT

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Physical therapists are key to achieving the National Pain Strategy's goal to reduce the burden and prevalence of pain and to improve the treatment of pain. This 2-day pre-conference course will provide you with the latest pain science and evidence-based evaluation and treatment skills you need to successfully treat patients in pain and help meet this national goal. Experts in pain science, pharmacology, psychology, sleep, nutrition, motivational interviewing, mindfulness and mindful movement will share their knowledge and skills. You will have a chance to practice pain evaluation, education and treatment techniques. The role of telerehabilitation to address the needs of patients unable to access physical therapy in person will be included. Case presentations will provide you with clinical reasoning insights and understanding. Join your colleagues for what will surely be an exciting, engaging and dynamic 2 days of learning!

—Presenters—

Kristin Archer, PT, DPT, PhD
Vanderbilt University Medical Center, Nashville, TN

Janet Bezner, PT, DPT, PhD
Texas State University, San Marcos, TX

Stephanie Carter Kelley, PT, PhD, OCS, CYT
Yoga Physical Therapist, Dublin, OH

Dana Dailey, PT, PhD
University of Iowa, Iowa City, IA

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President's Message

Carolyn McManus, MSPT, MA

Dear Members,

I am happy to report a proposal for a preconference course on pain science and treatment coordinated and submitted by PMSIG Vice President and Education Chair, Nancy Durban, PT, DPT, was accepted for CSM 2018. Nancy and the PMSIG Board are bringing together leaders in the field of pain for this 2-day event, Keep Calm and Treat Pain. In addition to the PMSIG, this course is sponsored by the APTA and Orthopaedic Section. Presenters and topics are: Kathleen Sluka, PT, PhD, on The Science of Pain (Day 1) and Pain Education (Day 2), Alexandra Szabova, MD, on Pain Pharmacology, Kristin Archer, PT, DPT, PhD, on Pain Psychology, Janet Bezner, PT, DPT, PhD, on Motivational Interviewing, Michelle Finnegan, PT, DPT, on Pain Inventories and Objective Measurement, Carolyn McManus, PT, MSPT, MA, on Mindfulness and Pain Treatment, Stephanie Carter Kelly, PT, PhD, on Mindful Movement, Activity and Exercise, Catherine Siengsukon, PT, PhD, on Sleep and Pain, Megan Pribyl, PT, MSPT, on Nutrition and Pain, Nancy Robnett Durban, PT, DPT, on Clinical Decision Making and Dana Daily, PT, PhD, on Telerehabilitation. In addition, there will be case presentations and opportunities to discuss the challenges and controversies in our field. The course will combine didactic presentations with experiential exercises and lab practice. We hope to see you at this engaging and dynamic 2 days of learning. Please let your colleagues know about this exciting educational event! See page 228 for further information. If your organization will be a vendor at CSM 2018 and would like to be a sponsor for this preconference course, please contact Nancy Durban at nancy.durban@cchmc.org.

More CSM 2018 news! The PMSIG is co-sponsoring a special symposium entitled, The Chronic Pain Epidemic: National Initiatives for Researchers, Educators, and Clinicians. This symposium will highlight recent initiatives by federal agencies and the APTA focusing on pain and feature Linda Porter, PhD, Director of Pain Policy at NIH and Co-chair of the National Pain Strategy, David Thomas, PhD, Director of the NIH Centers of Excellence in Pain Education and Program Director at the National Institutes of Health, and Justin Moore, PT, DPT, CEO, of the APTA. Kathleen Sluka, PT, PhD, will introduce the challenges of pain and program speakers that will be followed by an open panel discussion. Hope to see you at CSM 2018 for this unique, informative, and inspiring educational opportunity!

In addition to CSM 2018 planning, the PMSIG Board and volunteer members have continued to identify and get to work on new initiatives. We are excited to bring the PMSIG to the world of social media! I want to thank PMSIG members Tasha Parman, PT, DPT, OCS, and Megan Mitchell, SPT, from the University of Maryland, and Orthopaedic Section Public Relations Committee Chair, Mark Shepherd PT, DPT, OCS, for their time and effort in this task. Pain SIG members can find us on Facebook and Twitter; we look forward to connecting with all of you in the future! If you are not currently a Pain SIG member, Orthopaedic Section members can join for free.

Those of us practicing in this field appreciate that physicians and other health care providers often do not know, understand, and/or appreciate what PT can do to help patients with pain conditions. To address this concern, PMSIG members Katherine Beissner, PT, PhD, and Chad Garvey, PT, DPT, OCS, have volunteered to develop a PowerPoint presentation on the topic of pain and its treatment by physical therapists suitable for presenting by PMSIG members at physician and other health care provider professional conferences. We are grateful to Jason Beneciuk, PT, DPT, PhD, MPH, for taking time to share his ideas and experience with us. Jason participated in a NEXT 2017 panel discussion on bridging the gap between PT and primary care physicians and presented a physical therapy perspective on low back pain treatment at the Pain Care for Primary Care conference in Orlando, Florida sponsored by the American Pain Society and Global Academy for Medical Education. We will keep you informed as we move forward with this initiative.

The Clinical Practice Guideline (CPG) Development Group, under the leadership of Dave Morrissette, PT, PhD, OCS, continues their work to develop CPGs for musculoskeletal pain conditions. The CPG Development Group will reach out to those who have volunteered for the literature review when your expertise is needed.

The PMSIG Board highly values the research interests and clinical expertise of our members. If you would like to contribute to our monthly emails, please submit a research topic to Dana Dailey PT, PhD, at dana.dailey@uiowa.edu or a clinical pearl to me at carolyn@carolynmcmanus.com.

Thank you to all who have offered ideas for the PMSIG Strategic Plan. I have identified initiatives associated with Member Engagement, Physician Awareness, Standards of Practice, Educational/Professional Development, Public Awareness and Resources, and Expanding Access to PMSIG Membership. The proposed Mission Statement is, The Mission of the Pain Management Special Interest Group is to promote excellence in pain education, treatment, and research by physical therapy professionals. The proposed Vision Statement is, The Pain Management SIG will be a leading authority in role of physical therapy in promoting healing, well-being and movement by people with pain conditions.

I would now like to introduce you to Derrick Sueki, PT, DPT, PhD, OCS, FAAOMPT, and Amy Ngo PT, DPT. Derrick is co-owner of Knight Physical Therapy in Garden Grove, CA and on faculty in the Department of Physical Therapy at Azusa Pacific University. He is Chair of the Orthopaedic Special Council, on the Pain Education Clinical Practice Guideline Workgroup, a Chief Editor of two orthopedic textbooks, and has authored numerous works in textbooks and peer-reviewed journals. Derrick specializes in the science and management of chronic pain. Amy Ngo, PT, DPT, is a practicing clinician at Knight Physical Therapy and adjunct faculty member at Mount Saint Mary's University where she teaches pain science coursework. Amy's clinical responsibilities include orthopaedic physical therapy and the management of patients with persistent pain. I want to thank them for contributing the following article on the role of fear in the development and treatment of chronic pain.

Factoring Fear: Fear Conditioning and Extinction and Their Role in Chronic Pain

Derrick Sueki, PT, PhD (ABD), DPT, GCPT, OCS, FAAOMPT
Amy Ngo, PT, DPT

Everybody is afraid of something. Whether it is spiders, snakes, heights, or needles, fear plays a crucial role in everyday survival. When we are confronted with a dangerous or threatening situation, we physiologically respond with heightened adrenaline, increased heart rate, and quicker muscle responses. These responses enable us to react to the threat, allowing us to survive as an individual and collectively as a species. Fear, therefore, is a survival based protective response meant to warn us of danger and threat to life. But what happens when a person begins to fear pain or movement?

Increasingly, fear has begun to play a more prominent role in pain related research as several systematic reviews,[1-3] randomized control trials,[4,5] and theoretical reviews[6-8] have been dedicated to the potential role of fear in pain chronicity. Despite the growing recognition of the relationship between fear and pain chronicity in the literature, dissemination of these findings into the education of students and into clinical practice has been slow. The purpose of this narrative is to briefly give an overview of the potential link between fear and chronic pain and to lay the groundwork for future research, education, and clinical implementation.

While it would seem natural we are pre-programed with built-in fear and protective responses to allow us to instinctively respond to a threat, research on young children and animals suggest there are very few innate human fears. The fear of falling, the fear of loud sounds, and the fear of objects coming close to us are consistently noted as fears that we are born with.[9] Remaining fears are acquired or learned from the events of our lives or by examples and cueing received from those around us. While most fear is learned, an individual's response and acquisition of this learned fear vary. It is believed there are specific fear responses that are epigenetically programmed into our DNA to allow us to learn more rapidly.[10] These responses have been programmed into our genetic make-up and passed on from generation to generation to ensure quicker fear acquisition. These pre-programmed responses may not be expressed in every generation or every individual, but if presented with specific stimuli in the right context, these fear responses will manifest quicker and in many cases more expressively. For example, a rapid acquisition of the fear of snakes is needed less by people living in the city and more by people living in the desert. From an adaptation perspective, these epigenetically pre-programmed learned responses allow for individuality and change between generations and from individual to individual. If these fears were innately coded to express in each person, there would be no opportunity for growth as a species.

Studies of Pavlovian fear conditioning give us the greatest insight into how these fears are acquired. In Pavlovian fear conditioning, a conditioned stimulus (non-threatening stimulus) is paired with an unconditioned stimulus (noxious stimulus) and introduced to a subject. For example, a smell and an electrical shock are administered to a subject at the same time. This process is repeated or the intensity of the noxious stimulus is increased until the subject demonstrates a fear response to the previously non-threatening stimulus. In other words, the subject develops a conditioned response and begins to fear the smell. Young children have been conditioned to fear a white mouse by pairing exposure to the mouse with a loud noise. In this study, the fear conditioning produced crying following exposure to a white mouse.[11] This phenomenon is also evident in individuals with chronic pain. With chronic pain, fear and neutral stimuli can become conditioned together so a previously neutral stimulus can produce fear based painful responses.

Evidence consistently demonstrates contextual cues and pain processing regions in the brain play a significant role in the acquisition and shaping of eventual fear responses.[12] Contextual cues can take on a multitude of forms. During an injury, sights, sounds, smells, proprioceptive, hormones, and emotional cues are all stored together so these exteroceptive and interoceptive cues become powerful modulators of fear or pain memories and can be linked to fear producing events.[8] For example, while a loud sound may evoke fear in an unfamiliar dark alleyway at night, however, it may evoke joy and laughter during a July 4th celebration with friends. The contextual cues in both scenarios have shaped an individual's response. Recent research on associative learning has also significantly increased our knowledge on how and where contextual information is encoded in the brain in response to threat and danger. Both animal and human studies suggest the fear-producing stimulus is initially processed by the amygdala. This has led researchers to speculate the amygdala is responsible for triggering the initial fight or flight responses experienced in response to a fearful event. Once initiated, these amygdalar responses are quickly modulated by several loops of activity. The shorter loop of activity involves the hippocampus, a region believed to play a prominent role in temporal and contextual memory formation and storage. It stores fear memories and works with the amygdala to modulate original fear responses. The longer loop involves frontal brain areas such as the anterior cingulate, insular, and medial prefrontal cortex and also helps to in the processing of fear responses.[13] Together, these processing regions play a vital role in storing long-term contextual memories and shaping fear responses.

Clinical research involving posttraumatic stress disorder (PTSD) provides a clear illustration of how fear can be conditioned to produce physiological responses such as hypervigilance or withdrawal.[14] The literature consistently demonstrates that in subjects with PTSD, contextual cues can be associatively linked to fear producing conditioned responses such as fight, flight, or freezing.[12] While the neurophysiology underlying these responses is still being explored, evidence suggests individuals with PTSD have altered activity and structural changes in the previously mentioned areas involved in contextual processing. These changes may account for the long-term fear responses typically experienced by people with PTSD. In these individuals, contextual cues such as a loud noise or certain smell can trigger fear responses reminiscent of the original event.

While much is still unknown regarding the brain activity involved in chronic pain processing, preliminary evidence shows marked similarities between PTSD and chronic pain.[15] Imaging studies reveal in both individuals with PTSD and chronic pain, activity and structural changes include hyperactivity and hypertrophy of the amygdala and hyperactivity and atrophy of the hippocampus. This suggests an increase in fear conditioning and an altered ability to contextualize a painful stimulus among both groups. The activity of the anterior cingulate cortex and prefrontal cortex are also altered in subjects with chronic pain. This implies that similar to individuals with PTSD, contextual memory, asso-

ciative learning, and a person's past traumatic experiences may be instrumental in the development of fear memories and when contextually cued, these fear memories produce pain.

As we attempt to bridge the gap between science and clinical practice, it is important to focus on several key findings. Firstly, past history of trauma and fear are key aspects of learned fear responses. Secondly, contextual cues are important in the shaping and modulation of pain and can often trigger pain responses. Thirdly, and most importantly, fear and pain conditions can be extinguished.[16,17] The fact that fear and pain responses are learned and not innate indicate these responses are flexible and can be reprogrammed restoring the brain to normal patterns of activity following the extinction of fear or pain.

While strides have been and continue to be made to bridge the gap between research and clinical practice, the role of fear, context, and pain memory is lacking. Research demonstrates fear of a conditioned stimulus can be eliminated but this fear can return in the presence of contextual cues that have become linked with the fearful stimulus.[12] Translation…contextual cues that occurred during an initial injury can be a stimulus for a person's current pain. Clinically, reducing pain in a clinical setting may initially reduce symptoms, but they are likely to return when individuals encounter the original contextual cues. Clinicians are missing a major aspect of long-term pain and fear reduction unless they begin to address these contextual cues through education and exposure. Athletes returning to a sport should complete final phase rehabilitation not only on the field, but also with the sights, smells, and sounds common to the sport. This can be done through actual game simulations or accomplished through visualization and the use of technology. Similarly, these concepts can be used in the rehabilitation of chronic pain patients. Identifying contextual cues that may trigger pain responses and exposing the patient to these triggers in a safe and protected manner are a key aspect of the rehabilitative process. A gradual increase in exposing the patient to real-life situations while integrating memories and cues of the pain producing activity is an important part of completing the rehabilitation process. Interventions such as pain education, movement re-education, graded exposure, mirror therapy, and mindfulness should focus on incorporating fear producing environmental cues and triggers to reduce the fear and to reprogram the memories associated with the injury.[18] Clinicians should also bear in mind the original injury may very well be an event that happened in the past and was retriggered by more recent activities.

Fear based pain research is still in its infancy and in most cases, the results are mixed. While this clinical perspective is brief, it is meant to give readers a taste of what research is currently being conducted by our lab at Azusa Pacific University and by others around the world examining the role of fear in the development of both short- and long-term pain memory and the application of these findings into clinical practice.

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CLINICAL IMAGING

Independent Study Course 27.3

Learning Objectives

1. Describe the importance of having physical therapists study imaging.
2. Identify relevant anatomy on diagnostic images.
3. Define the different types of musculoskeletal imaging and the distinguishing information gathered from each.
4. Understand basic radiographic terminology and the basic principles of radiography.
5. Discuss factors that influence resolution, quality, and interpretation of imaging.
6. Discuss basic viewing strategies for plain film, computed tomography, and magnetic resonance images.
7. Discuss differences among and indications for various imaging methods and modalities.
8. Understand the clinical decision making model for determining image sequence using American College of Radiology-Appropriateness Criteria and other clinical prediction rules.
9. Understand the use of evidence-based guidelines for application of imaging modalities for musculoskeletal disorders of the extremities.
10. Discuss the imaging findings for musculoskeletal disorders of the spine and extremities in the context of clinical presentations of patients.
11. Identify signs and symptoms of red flags and specific causes of spine pain that require emergent referral and/or immediate imaging.
12. Appropriately refer patients with acute and chronic spinal disorders for diagnostic imaging based on clinical practice guidelines.
13. Synthesize available patient examination findings with imaging evidence to develop more effective intervention strategies.

Topics and Authors

Basic Diagnostic Imaging Principles
Ira Gorman, PT, PhD

Imaging of the Extremities
Deepak Kumar, PT, PhD, OCS
Amee L. Seitz, PT, PhD, DPT, OCS

Spinal Imaging: Update for the Treating Physical Therapist
J. Megan Sions, DPT, PhD, OCS
James Elliott, PT, PhD
George J. Beneck, PT, PhD, OCS, KEMG
Charles Hazle, PT, PhD

Description

This monograph series covers an introduction to the basic principles underlying the science and diagnostic utility of imaging for the physical therapist. The first monograph is a primer that discusses principles of conventional plain film radiographs (x-rays); computed tomography (CT) scans, magnetic resonance imaging, ultrasound imaging; diagnostic ultrasound and rehabilitative ultrasound imaging; and nuclear imaging. The second and third monographs cover imaging for the extremities and spine and its role in the evaluation of select musculoskeletal injuries. Application of the material is enhanced through the presentation of case studies.

Continuing Education Credit

Fifteen 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.

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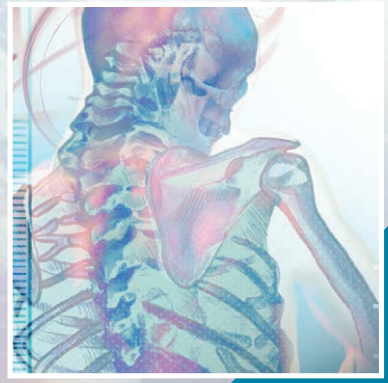

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Additional Questions—Call toll free 800/444-3982

ORTHOPAEDIC SECTION
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APTA
American Physical Therapy Association

CSM Preconference Course

On Wednesday, February 21, 2018, a one-day imaging course will be held prior to the start of Combined Sections Meeting in New Orleans. The preconference course, entitled "Achieving Clinical Correlates: Imaging Implications for Physical Therapists," will be from 8 a.m. to 5 p.m. and will be conducted by a team comprised of Brian Young, Bob Boyles, James Dauber, and Chuck Hazle. This is a collection of seasoned practitioners, educators, and authors with extensive experience with diagnostic and procedural imaging. Perhaps equally of value for clinicians and educators, this course will target the critical information in relating medical screening and daily decision-making by physical therapists to imaging.

CSM Programming

As the scope of physical therapy practice gradually allows imaging privileges in more states and efforts evolve in these jurisdictions toward changes or interpretations in practice acts, many may be interested in what can be learned from those with experience in obtaining and using these privileges. The Imaging SIG sponsored programming at CSM 2018 is entitled "Referral for Imaging in Physical Therapist Practice: A Pragmatic Vision." This programming consists of contributions from those who have successfully managed or initiated imaging privileges on the institutional and state levels. Additionally, APTA staff will contribute the changing landscape nationally and describe APTA's mission and vision relating to imaging in physical therapist practice. The speakers for this session are Aaron Keil, Scott Rezac, Kip Schick, Bill Boissonnault, and Angela Shuman. Jim Elliott is coordinating the multi-presenter effort. Those with an interest in state advocacy efforts currently or perhaps in preparation for the future would likely benefit the most from this session. Please call this session to the attention of your state association leadership.

Election

In November, the Imaging SIG will have elections for two positions: Vice President and Nominating Committee Member. These are both 3-year terms. The role of the Vice President is that of leading the educational effort, including assembling proposals and submissions sponsored by the Imaging SIG to CSM and other meetings. The Nominating Committee position is capped by being Chair the last of the 3 years. Please be on the lookout for information from the Orthopaedic Section about the candidates and the voting process. You should receive e-mail correspondence describing the election procedures along with statements from the candidates.

Update on Research

Research Chair, George Beneck continues to shepherd the SIG Research Committee with multiple projects underway. All of these undertakings are ambitious with potentially far-reaching consequences. Their work can essentially be categorized in 3 areas: (1) a survey of physical therapist attitudes and beliefs regarding imaging, (2) a comparison of physical therapist imaging referral patterns between military and civilian settings, and (3) the appropriateness of decision-making of physical therapists ordering radiographs. Among those contributing to this are Connie Kittleson, Rob Worth, Dennis Kaster, Aaron Keil, Murray Maitland, Teonette Valasco, Sean Rundell, Scott Rezac, John Garbecht, Donald Goss, Rob Manske, Kip Schick, and Michael Crowell.

Scholarship Available

Very likely by the time this appears in print, the new scholarship established by the Imaging SIG will be accepting applications for its first recipient. The intents of the scholarship are many and include raising awareness of the topic of imaging in physical therapy practice, stimulating student and novice practitioner interest in imaging, and increasing visibility of the Imaging SIG. More details about this will be distributed through e-mail, the Imaging SIG's social media, and the Imaging SIG's web pages on the Orthopaedic Section website. The Scholarship Committee consists of Murray Maitland (chair), Lena Volland, Andrew Smith, Becky Rodda, and Meg Sions. They have formulated the application and selection process with the availability of the scholarship being announced this fall. We hope to award the first scholarship at CSM in New Orleans.

Partnership with AIUM

For several months, APTA staff with representatives from the Imaging SIG have been working with the administration of the American Institute for Ultrasound in Medicine (AIUM) to add specific language inclusive of physical therapists in the organization's training guidelines. Existing language has included only physicians and chiropractors with physical therapists being conspicuously absent. Through a process lasting approximately one year through multiple meetings and extensive correspondence, the effort continues with a favorable outcome being very likely.

On August 3rd, Mohini Rawat, DPT, ECS, OCS, RMSK, presented a one-hour webinar for the AIUM for over 120 attendees. This is the first occasion that an educational session for this organization has been led by a physical therapist. The title of the presentation was "The Value of Ultrasound Imaging in Peripheral Nerve Pathology." In addition to completing a presentation of approximately 55 minutes, Dr. Rawat answered multiple "live" questions from the webinar attendees. The AIUM's follow-up survey of those participating reflected very favorable reviews on content expertise and the quality of the presentation. This was an excellent foundational step to building an on-going partnership between APTA (particularly the Orthopaedic Section and Imaging SIG) and AIUM. We expect to partner in many educational efforts in the future.

Ultrasound Imaging and Physical Therapist Credentialing

With contributions by Julia Lee, Director of Marketing and Communications, Inteleos - ARDMS – APCA

With the increasing popularity and evidence-supported utility of diagnostic and procedural ultrasonography, a growing number of physical therapists are choosing ultrasound imaging to enhance their clinical assessment and reasoning skills. As part of this process, many are also electing to pursue certification to validate their

ultrasound proficiency to other professionals, the public, and to payers.

The Registered in Musculoskeletal® (RMSK®) sonography certification, awarded by the Alliance for Physician Certification & Advancement™ (APCA™), seeks to raise the standard of musculoskeletal ultrasound practice worldwide and promote best practices for enhanced patient safety. Through this advanced certification, physical therapists demonstrate their expertise in musculoskeletal ultrasound and reap a variety of benefits including accurate diagnoses, improved patient care decision-making, peer recognition and increased marketability as experts in musculoskeletal-related conditions.

In 2012, the RMSK certification examination was first introduced and administered by the American Registry for Diagnostic Medical Sonography (ARDMS), in response to one of the fastest growing sonography applications, the evaluation and treatment of joint and soft-tissue disorders. In just a few years since its launch, hundreds of physicians and advanced care practitioners of multiple disciplines, including physical therapists, have demonstrated knowledge and distinguished themselves as experts in musculoskeletal ultrasound.

For physical therapists, earning the RMSK certification provides a critical edge in promoting themselves as preeminent practitioners in musculoskeletal sonography. The first step in the process of obtaining the certification is meeting the educational and professional prerequisites prior to applying for the examination. Once deemed eligible, applicants must pass the Musculoskeletal (MSK) sonography examination. The MSK examination requires applicants to be licensed, practicing physicians or advanced care professionals who have clinical musculoskeletal ultrasound experience. Visit www.APCA.org/MSK to view the specific MSK Prerequisites.

The education and professional requirements include attesting to having performed and/or authorized diagnosis of a minimum of 150 musculoskeletal ultrasound studies on live patients. Formally accredited continuing medical education courses are not required, but are highly recommended to assist in preparation for the MSK examination. Applicants are encouraged to review the content outline available at www.APCA.org/MSK. While at that website, interested clinicians can also sign-up to receive more information about the application and upcoming administration dates, learn about the application process, and get more details on the required application documentation.

The MSK examination takes approximately 4 hours to complete and contains 200 questions. The examination assesses the practitioner's knowledge of normal and pathologic anatomic features demonstrable by ultrasonography as well as understanding of ultrasound equipment and its operation. Completing the examination is similar to the National Physical Therapy Examination and involves scheduling the examination at a testing center subsequent to satisfying the required clinical and educational requirements along with completing the application process.

"The APTA has set a goal of attaining practice authority for imaging in physical therapy based on successful use of imaging privileges in other countries and in limited sectors in the US. As physical therapists increasingly become recognized as the practitioner of first choice for apparent musculoskeletal conditions, utilization of musculoskeletal ultrasonography is one measure physical therapists can undertake to enhance and elevate their clinical skills," noted Charles Hazle, President of the Imaging Special Interest Group. "Clinicians seeking advanced orthopaedic practice, particularly in a direct access environment, will prudently consider the value offered by achieving skilled use of musculoskeletal sonography and the benefits gained by obtaining the associated credentials, such as the RMSK, validating that expertise."

The Alliance for Physician Certification & Advancement™ (APCA™) administers examinations and awards certifications in the areas of physician vascular interpretation (RPVI and RPVI-China), musculoskeletal sonography (RMSK), and cardiovascular imaging (CBNC and CBCCT). APCA has nearly 20,000 certified physicians throughout the world and is part of the non-profit Inteleos™ family of certification organizations which also includes the American Registry for Diagnostic Sonography® (ARDMS®). APCA joins ARDMS in furthering its long-standing mission of raising the global standards of excellence in healthcare and patient safety.

NEW BUSINESS

1. ***ABPTRFE New Quality Standards:*** Please make sure to review the new Quality Standards that have been put in place and will be effective January 1, 2018.
   a. This includes a New Description of Residency Practice (DRP) in Orthopaedics. This will replace the traditional Descriptions of Specialty practice. There are now 57 different specific diagnoses that will have to be tracked on an annual basis replacing the previous body regions table.
2. ***Combined Sections Meeting:*** Save the Date and plan on having your residents or fellows show up a day early for a pre-conference course geared to give students, residents, fellows and novice clinicians an option to gain more 1:1 feedback on their manual therapy skills. Please share with your students, residents and fellows!
   a. "TRUST in YOUR THRUST! Implementing High Velocity Techniques into your Practice."
      • Wednesday, February 21, 2018
      i. Dr. Aaron Hartstein, Dr. Marwan Kublawi, Dr. Abe Shamma, and Ed Schiavone
3. ***Education Section Residency and Fellowship Special Interest Group (RFSIG) Collaboration***
   a. ***RFSIG HUB:*** As many of you know the Education Section also has a newly developed SIG where they too are trying to establish communication across residency programs and Sections. You will find information regarding curriculum development, mentorship, and research discussion on the APTA Communities HUB.
   b. ***RFSIG Think Tank:*** The RFSIG is trying to organize key members to assist in ideas for curriculum development, mentorship and research from each Section. The ORFSIG will be assisting the RFSIG to represent orthopaedic residencies and fellowships. More to come on this.
   c. ***Residency and Fellowship Specific Webinars:*** We are working on creating some educational webinars around key topics in residency and fellowship education. Please contact matthaberl@hotmail.com for any specific topics/presenters.

FOLLOW UP BUSINESS

4. ***Elections:*** You should have received a "Call for Candidates" in the June issue of *OPTP,* as well as via the Orthopaedic Section's electronic "OsteoBlast." The call for Candidates will close September 18, 2017 and voting will occur November 1-30. We are seeking calls for:
   a. President
   b. Vice President
   c. Nominating Chair- 3-year term
   d. Nominating Chair- 2-year term
   e. Nominating Chair- 1-year term
5. ***Strategic Plan, Goals, and Objectives:*** A WebEx Strategic Planning Meeting was held on **Tuesday, June 13th at 7pm CST** where you can find the meeting minutes, PowerPoint, and link to the meeting on our Facebook page
      i. ***Link:*** https://www.orthopt.org/content/special-interest-groups/residency-fellowship/orf-sig-webinars
6. ***Budget Proposal:*** We will need to develop this in line with our strategic plan and goals. More to come on this as members should look for a survey to determine utilization of these funds.
   a. ***Potential expenses***
      i. CSM or other meeting Meet and Greet
      ii. Strategic Planning Meeting
      iii. Online Webinars / Continuing Education
      iv. Research development
7. ***Logo Contest:*** Thank you to Kris Porter and Stephen Kareha in assisting with establishing a logo and image for the SIG. Unfortunately, we only had two submissions. We were able to shoot some pictures through the Section office to be the banner of the SIG. Take a look at our new logos on the Section website!
8. ***Website Development:*** Our website is currently being developed. Here we will have resources to ORFSIG meetings, ABPTRFE updates, Curriculum Packages, Grants, etc. Please make any other requests by posting to our Facebook page.
   a. https://www.facebook.com/groups/741598362644243/
9. ***OPTP Quarterly Submissions:*** We are looking for scholarly submissions to highlight residency and fellowship education in the *Orthopaedic Physical Therapy Practice* magazine. This can serve as a resident/fellow scholarly project or any outcomes based research. Take a look at the example below!

As we can see we have several moving parts at this time. I look forward to the continued support of you members and want to thank all of those involved in moving the EIG forward.

Sincerely,
Matt Haberl
Chair, OREIG

Resident Case: Utilization of Percussion Test for Screening of Osteitis Pubic in Postpartum Runners

*Lisa J. Piropato, PT, DPT, SCS, ATC**
Matt Haberl, PT, DPT, OCS, FAAOMPT, ATC, CSCS
Erin Maslowski, MD
**Gundersen Health Sports Physical Therapy Resident, La Crosse, WI*

INTRODUCTION

Residency mentorship in the clinical setting is an important aspect of a resident's development from a novice to expert clinician. Pattern recognition is part of this growing process for residents. This is used by experienced practitioners in their specific areas of practice and is faster and more efficient than hypotheses-derived clinical decision making.[1] The purpose of this case report is to describe the clinical mentorship of a sports medicine resident in the identification of a patient with osteitis pubis using the patellar pubic percussion test (PPPT).

CASE DESCRIPTION

A 29-year-old woman was referred to physical therapy for progressively worsening right anterior hip pain and popping and accompanying left lateral hip pain. Three months earlier, and 1 week after delivering her first child, she started training for a marathon. At the time of beginning physical therapy, she was 8 months from delivering her child. The patient presented with a history being postpartum,

currently breast feeding, and recent return to high volume impact running. The patient described having significant difficulties returning to her premorbid functional state. Greatest limitation was fully striding out when initially starting to run. She reported doing better as the run continued but would feel her hips significantly tighten up immediately after the run and would continue to have soreness into the following day. Since she was training for a marathon, this greatly limited her training speed and intensity and caused her hip and groin pain.

The patient was initially treated for her left lateral hip pain which resolved with initial manual interventions, activity, and exercise modification administered by a sports resident. Her right hip initially responded well to long axis hip distraction with high-velocity low-amplitude thrust mobilizations which resulted in an increase in her flexion, abduction, and external rotation (FABER) range of motion. The patient however continued to be limited with her return to running goals and ongoing right pubic pain over the course of 3 weeks initiating a conversation with her primary clinical mentor and further reassessment.

Objective findings included palpable findings of diastasis rectus, tenderness on right pubic bone at the proximal adductor attachment, an inability to activate her transverse abdominis and pelvic floor muscles, and impaired hip adductor flexibility with FABER test. Symptoms and objective findings were suggestive of a pubic stress reaction with underlying neuromuscular control deficits of her pelvic and intrinsic hip musculature. Upon dialogue with the clinical mentor further screening was indicated to rule out possible bony lesion and determine whether further referral may be indicated.

Resident education had advocated PPPT as a viable evaluation tool to rule in possible fractures supported by a specificity of 95% and positive likelihood ratio of 20 when positive.[2] The PPPT has also demonstrated utility in identifying bony lesions beyond those of the femur. This test is performed by placing the bell of a stethoscope on the pubic bone while using a tuning fork on the patella and working towards the pubic symphysis at various bony prominences.[3] In this case, the tuning fork was first placed on each patella, with no abnormalities detected. When placed on the right anterior superior iliac spine (ASIS), a difference in resonance was noted when compared to the left, indicating a positive test. Vibration of the tuning fork on the right ASIS also induced pain, which the patient described as a "deep ache" in her pubic area.

Owing to this finding, discussion between the resident and mentor determined further referral was indicated for collaborative care with the patient's medical provider to determine the extent of bony involvement. Communication with the referring provider ensued where the most cost efficient option would be a nuclear bone scan with single photon emission computed tomography (SPECT) imaging to further identify the extent of possible stress reaction (Figure 1).[4] Further findings demonstrated increased uptake at the pubic symphysis on both delayed phase imaging of the bone scan and SPECT. Additionally, right greater than left irregularity and sclerosis of the pubic symphysis was noted on image SPECT consistent with osteitis pubis.

Following imaging, the patient was instructed to begin anti-inflammatory medications and to continue with physical therapy. The resident and mentor worked together on identifying low stress activities to the pelvis while still addressing her pelvic floor weakness, and hip inflexibility. The patient was educated on decreasing high impact aggravating activities such as running. Seven months after the diagnostic imaging the patient was able to complete her half marathon successfully without a recurrence of hip or pubic pain.

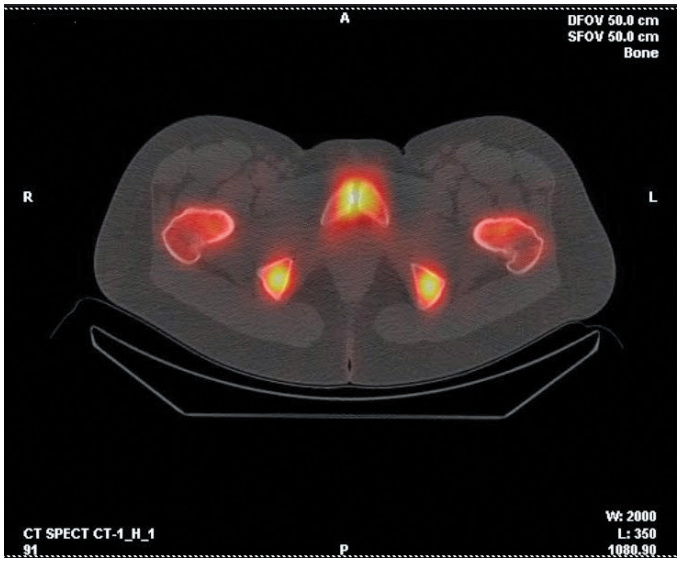

Figure 1.

CLINICAL RELEVANCE/DISCUSSION

Residency education has been described as "a way to advance a physical therapists knowledge and skills in patient/client management."[5] One key element in advancing one's knowledge and skills is through clinical mentorship. Clinical mentorship during this case led to efficient management of a patient with ongoing hip pain. In this case, the patient was seen for 3 visits prior to the recognition of alternative diagnoses and referral back to her physician. The discussion between the mentor and the resident revealed limited improvement with current treatment techniques highlighting an unexpected response to care. Due to the resident's limited previous experience with this diagnosis and the expected therapeutic response, the resident was able to clinically reason through other evaluation and treatment interventions with the assistance of her mentor. In this case, the percussion test was a new evaluation tool for the resident where the mentor was able to educate on modifications to the technique in localizing different anatomical structures in screening for bony abnormalities. Without clinical mentorship in this case, the resident would have continued to treat this patient prior to sending back to the physician for further screening, which would have prolonged the process of recovery.

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President's Message

Kirk Peck PT, PhD, CSCS, CCRT, CERP

Animal Rehabilitation at APTA Combined Sections Meeting

I might appear to be a shameless promoter of the APTA Combined Sections Meeting since it is addressed so frequently in the SIG's President's Messages, but the reality is CSM is where the action takes place for ARSIG business and educational programming. So mark your calendars to be physically present in historic New Orleans next February where you will have an opportunity to learn from two great speakers, Jeanine Freeberg, PT, DPT, C/NDT, and Amie Lamoreaux Hesbach, PT, DPT, MS, CCRP, CCRT. Both speakers will share their collective wisdom on the topic of managing neuro-related pathologies in the canine client by using the theory and concepts of proprioceptive neuromuscular facilitation and neurodevelopmental techniques. Preceding the two-hour presentation will be the ARSIG annual business meeting where many topics of interest will most certainly occupy the agenda.

ARSIG Practice Analysis Survey Update

Data from the completed ARSIG animal practice survey has been collected, and is currently being analyzed. The goal is to have a draft summary of results to report for CSM in 2018 where even more discussion on the results will be encouraged. The focus of the practice analysis is to describe the current state of animal rehabilitation in the United States and is based on respondents who completed the online survey.

Physical Therapists Who Treat Animals – Competence Does Matter

Over the past few years I have received many inquiries from interested students and licensed physical therapists regarding the qualifications needed to treat animals. Unfortunately a small percentage of those inquiring believe that physical therapists should be able to treat animals without obtaining additional education or competencies. To be honest, I am somewhat surprised by this assumption since physical therapists know how much education was required to obtain their license for the privilege to practice on human clients.

It goes without saying, if an individual lacks foundational knowledge regarding basic human anatomy, applied physiology, neurology, and biomechanics, they will fail to possess the necessary competencies to appropriately apply evidence-based rehabilitation techniques. So why would it be any different if the patient happens to be a furry little canine or super-sized equine? The fact is, dogs, horses, and other animals each have their own unique anatomy, physiology, biomechanics, and pathologies that require specific knowledge and competencies to be appropriately treated by qualified practitioners.

Veterinarians certainly do not learn everything there is to know about one specific animal and then automatically translate that knowledge to evaluate and treat all other species. So why should physical therapists be any different when translating their human skills to become proficient in treating animals? The answer should be obvious…physical therapists need additional education and competencies to adequately and safely redirect their clinical reasoning skills to species that are very different than humans in both structure and function, let alone behavior and attitude. Below are a few fun facts that exemplify how important it is to know the differential anatomy between animals and humans.

Statistically speaking humans who dislocate their patella will do so laterally, while in most dogs, the condition is more prone to occur medially. Humans and dogs each have one patellar tendon, but in a horse you need to count to three. Equine stifle anatomy allows horses to sleep standing up…a phenomenon that humans and dogs find impossible without external support. If a human injures the biceps tendon, it could be either the long or short head. Dogs, on the other hand, only possess a long-head even though the structure is still called a "biceps." And oh yes, what about those pesky triceps in dogs that really constitute 4, not 3 heads. Or, how a horse possesses muscles called the supraspinatus and infraspinatus, but their primary function is far from focusing on humeral head external rotation.

These are only a few examples that may challenge the clinical reasoning processes by cross-trained practitioners who cognitively toggle between human and animal anatomy. These brief examples do not even mention the more complicated topic of differentiating various musculoskeletal, neurologic, and medical diagnoses.

So yes, having proper qualifications to treat animals does matter, and should matter for the sake of public and consumer safety…and safety for the PT provider as well. This is especially important considering that animals are technically unpredictable patients lacking formal verbal communication abilities, and can react to the most benign situations by causing potential harm to those around them. However, I must emphasize that it is amazingly fun and challenging learning how to best apply one's PT knowledge and skills to effectively treat animals, and also to experience the personal gratification of witnessing positive outcomes for both animal client, and accompanying human companion(s). So if you have a desire to treat animals, the journey is well worth the effort.

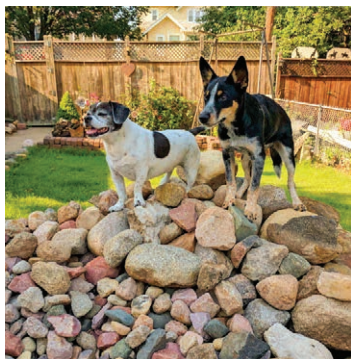
Scholars

Hallelujah…after multiple requests for SIG members to submit articles for the *OPTP*, we finally have a winner in this edition. This is a grand victory indeed. However, it does not change the fact that I will continue to beg for more submissions related to the practice of animal rehabilitation or sport performance. Review articles, abstracts, case studies, novel treatment techniques, interesting clinical anecdotes, etc. Just make sure your article applies to animal rehabilitation in some way, and all the stars will align. Please remember however, article submissions with citations and references must be formatted in AMA Manual of Style for publication.

Contributory Acknowledgment

In this edition of *OPTP* Georgia Bottoms, MSPT, from beautiful Savannah, GA submitted a thought-provoking article on the canine cruciate ligament, and the importance of recognizing the mechanics that predispose this structure to potential injury. Georgia's article also nicely emphasizes the importance as to why

PTs need to acquire additional education in animal anatomy and pathology to truly provide the highest level of care.



One "Double Dog" on the Rocks Please!!

Photo Courtesy of Kirk Peck: "Bella & Scout"

Contact: Kirk Peck,
President ARSIG
Office (402) 280-5633
Email: kpeck@creighton.edu

The Canine Cranial Cruciate Ligament Rupture

Georgia Bottoms, MSPT

Rupture of the cranial cruciate ligament (CCL), a structure comparable to the anterior cruciate ligament in humans, is one of the most common orthopedic injuries in dogs.[1] The CCL is composed of 2 separate and distinct bands. In the case of partial ligament tears only one of the bands is typically disrupted, but with a complete tear both bands are torn. The main function of the CCL is to prevent cranial tibial thrust. Thrust occurs when the tibia translates anterior with respect to the femur, similar to the function of an anterior cruciate ligament (ACL) in humans. Both human ACLs and canine CCLs limit internal rotation of the tibia on the femur in addition to preventing hyperextension, also known as the screw home mechanism in humans.[2] The demands of the CCL in dogs however differ from their human counterparts. In humans, the ACL is primarily under stress with more dynamic movements, whereas just static standing for dogs creates tension on the CCL. Most tears are due to biomechanical wear and tear, not trauma as in humans. The medial meniscus is concurrently torn in about 30% to 50% of CCL tears secondary to added stress placed on the caudal horn of the meniscus.[1]

There are many factors that predispose dogs to rupturing the CCL. These include age, weight, breed, genetics, joint conformity, altered biomechanics, and blood supply, but the most correlating factor is the tibial plateau angle (TPA).[3] In dogs, it is believed that excessive TPA can lead to greater tension on the passive stabilizers such as the CCL, thus predisposing it to tearing. An excessive TPA slope will cause the CCL to remain constantly taut and consequently unable to maintain consistent integrity of the ligament during daily activities such as walking and running.

Experts have shown that the TPA of the greyhound dog positioned at 22.5° is a standard for determining the risk for tearing the CCL in all other breeds since the greyhound rarely ruptures this ligament.[4] By comparison, the mean TPA standard for the human ACL is 10°. A research study by Wilke et al demonstrated that the slope of the tibial plateau is an important factor determining CCL ruptures in Labradors.[4] Evidence by Comerford et al may account for this finding as their research concluded that ligaments were weaker in the Labrador breed.[5] Whitehair et al found the incidence of ligament disruption higher between 7 and 10 years of age.[3]

In a study of 438 dogs treated with a tibial plateau leveling osteotomies (TPLO) less than 10% had radiographic signs of osteoarthritis in the joint 2 years postsurgery.[6] A study found that once the proximal tibia is rotated, dogs who had a post-op tibial plateau angle between 2° and 14° demonstrated better performance on clinical measures. However, the original recommendation by Slocum and Slocum is 5°.[7] When the rotated angle is from 5° to 10°, cranial thrust is eliminated and a dynamically stable joint is then created.

To further explore the phenomenon of CCL tears, the author of this article extrapolated data collected from January 2015 to August 2017 for TPLO performed on 352 dogs by a board-certified surgeon for Fetch Canine Rehab (eg, author's site of employment). The TPLO is a type of surgery for CCL rupture that rotates the proximal aspect of the tibia to decrease the excessive slope and anterior translation since the torn ligament is not replaced or repaired in canines as it is in humans.

The author separated data from the 352 dogs into 4 groups; large (>50 lbs.) and small breeds (<50 lbs.), and Labradors and mix breeds to determine if there was a statistically significant angle that predisposed dogs to tearing the CCL. The criterion used in reviewing data was a TPA of 22.5° as noted previously by Wilke et al.[5] Of the 352 dogs, 92 were large breed with a mean TPA of 31.6°, 49 were small breed with a mean TPA of 34.9°, 155 were mixed breed with a mean TPA of 33.0°, and 56 were Labradors with a mean TPA of 30.3° (Figure 1).

Unlike humans, 50% of dogs will tear the opposite CCL within 1 to 2 years of tearing the initial side according to Comerford et al and Griffon.[5,8] The hypothesis for such a high incidence of contralateral tearing relates to the excessive slope in the nonsurgical stifle as compared to the corrected angle in the surgical knee. The higher incidence is also related to osteoarthritis. It is also possible that the unaffected stifle may already have partial tearing of the CCL which may progress to a complete tear during the recovery period from the initial surgery due to increased compensatory loading on the nonsurgical leg.

As with human rehabilitation, physical therapy is also an imperative step to improving a dog's overall functional mobility and quality of life by decreasing postsurgical pain and edema, and improving muscle mass, range of motion, and normalizing weight bearing status during the recovery phase. With appropriately structured rehabilitation approximately 90% of dogs who have CCL surgery will return to normal function.[9,10]

At Fetch Canine Rehab, the TPLO undergoes a 14 week recovery process, and even though protocols may vary between physical therapists, this author has concluded that separating the process

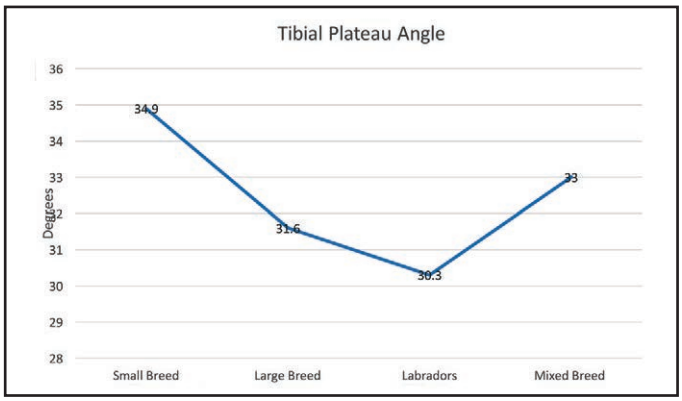


Figure 1.

of rehabilitation into appropriate phases will allow the canine patient to increase weight bearing incrementally with minimal loss of muscle mass and range of motion. The regimen for TPLO includes 4 to 6 weeks of skilled intervention to maximize the dog's functional mobility and allow them to reach their full potential. The most difficult aspect of rehabilitation is adherence by the dog's owner in maintaining strict crate rest and short leash walks for the first couple of weeks to allow proper bone healing.

Although many factors may lead to CCL tearing in the canine client, as noted, the excessive slope of the tibial plateau angle is the main predisposing element leading to this pathology. Research suggests that more studies are needed to effectively determine this conclusion. The study by Wilke et al concluded that since greyhounds and unaffected Labradors had similar standing TPAs, and although the TPA may be associated with damage to the cruciate ligaments, many dogs with steep TPA do not develop cruciate ligament disease.[4] By increasing the knowledge about tibial plateau angle and excessive slope, veterinarians will gain a better understanding of which surgical technique will be most beneficial, and thus refer to the most qualified board-certified surgeon. In addition, the implementation of a structured postoperative rehabilitation program by a skilled physical therapist is imperative to ensure the canine patient will return to maximal function and potential.

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Index to Advertisers

POSTOPERATIVE MANAGEMENT OF ORTHOPAEDIC SURGERIES

Independent Study Course 27.1

Learning Objectives

1. Describe anatomy of the hip joint and how structure can relate to pathological conditions.
2. Describe indications for surgical intervention and select surgical procedures of the hip.
3. Describe postoperative rehabilitation intervention techniques following hip surgery.
4. Know the common structures and pathomechanics involved in knee injury.
5. Describe the physical therapy guidelines, phases, and goals for a patient who has undergone knee surgery.
6. Understand the etiology of a calcaneal fracture, Lisfranc fracture/dislocation, and an Achilles tendon rupture.
7. Identify the advantages and disadvantages of surgical fixation versus closed treatment for calcaneal fractures.
8. Develop appropriate treatment plans for patients who have sustained a calcaneal fracture, Lisfranc fracture/dislocation, or an Achilles tendon rupture.
9. Synthesize the current evidence comparing conservative care versus early surgery in different subgroups of patients with cervical and lumbar spine pain.
10. Identify the clinical findings that identify patients who are most likely to benefit from cervical or lumbar surgical intervention.
11. Screen and appropriately manage postoperative complications for presented pathologies.
12. Develop an evidence-based rehabilitation program for patients who have undergone different cervical and lumbar surgeries.
13. Integrate biomechanics and pathomechanics of the shoulder to evaluation and treatment.
14. Implement evidence-based nonoperative treatment strategies for shoulder pathology.
15. Describe evidence-based rehabilitation guidelines following shoulder surgery.
16. Understand the anatomy and biomechanics of the elbow complex and how it relates to surgical interventions, tissue healing, and treatment.
17. Understand postoperative guidelines and treatment progression for the elbow complex.
18. Apply appropriate patient-reported outcome measures for select surgical procedures of the hip, knee, ankle/foot, spine, shoulder, and elbow.

Editorial Staff

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Description

This 6-monograph course covers postoperative management for injuries and pathology of the hip, knee, ankle/foot, cervical/lumbar spine, shoulder, and elbow. Each monograph addresses the anatomy and biomechanics of the structure, a review of select or common injuries, and nonsurgical and surgical management. Emphasis is placed on rehabilitation guidelines, precautions and contraindications to care, and also expected outcomes.

Topics and Authors

Hip—Keelan Enseki, PT, MS, OCS, SCS, ATC, CSCS; Dave Kohlrieser, PT, DPT, OCS, SCS, CSCS; Craig Mauro, MD; Michaela Kopka, MD, FRCSC; Tom Ellis, MD
Knee—Michael J. Axe, MD; Lynn Synder-Mackler, PT, ScD, FAPTA; Anna Shovestul Grieder, PT, DPT, OCS; Jeff Miller, PT, DPT, OCS, SCS; Melissa Dreger, PT, DPT; Michael Palmer, PT, DPT, OCS; Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA
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