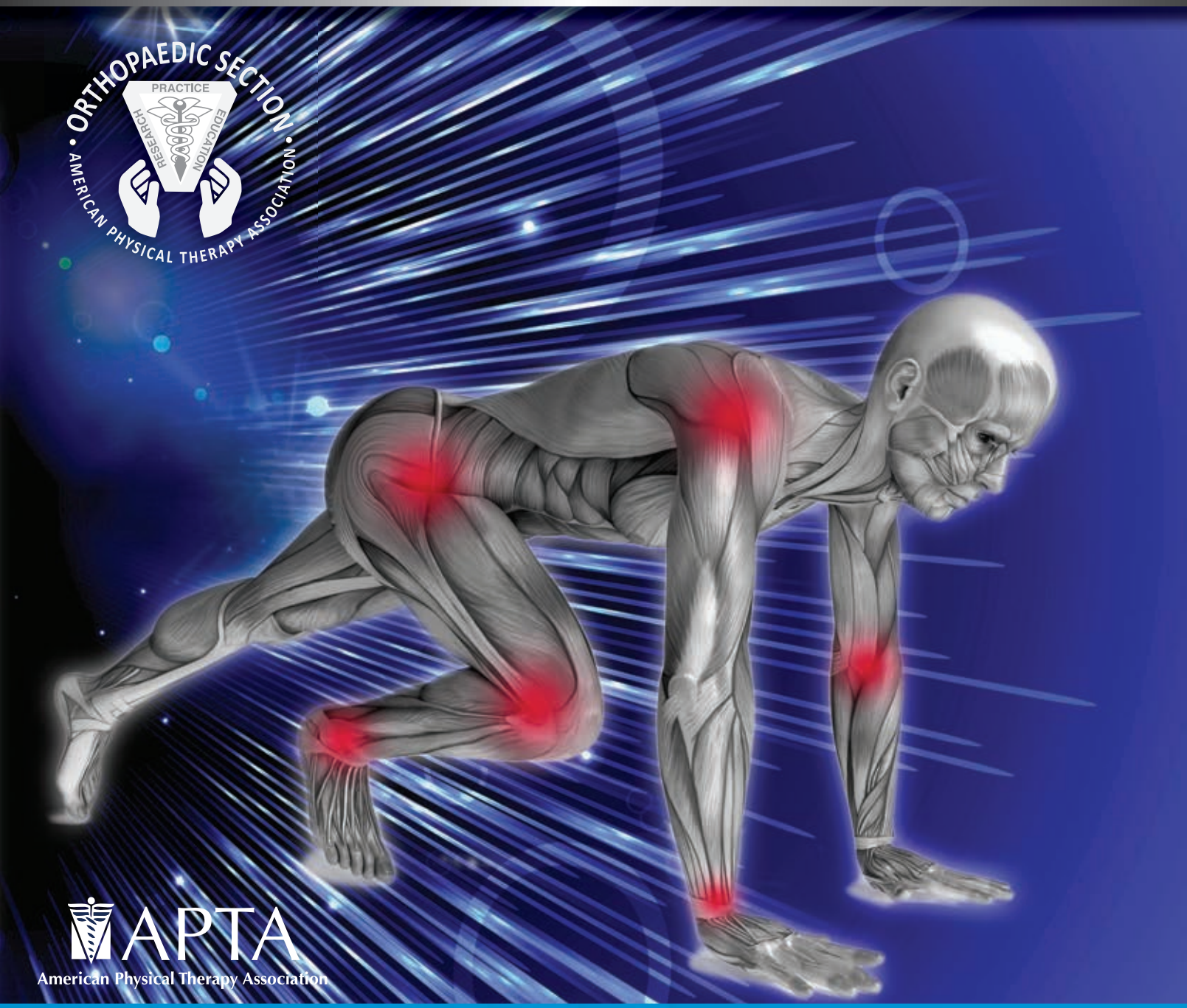
VOL. 28, NO. 2 2016

ORTHOPAEDIC Physical Therapy Practice



THE MAGAZINE OF THE ORTHOPAEDIC SECTION, APTA

ORTHOPAEDIC Physical Therapy Practice

In this issue

Regular features

VOL. 28, NO. 2 2016

OPTP Mission

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

Publication Staff

Managing Editor & Advertising
Sharon L. Klinski
Orthopaedic Section, APTA
2920 East Ave So, Suite 200
La Crosse, Wisconsin 54601
800-444-3982 x 2020
608-788-3965 FAX
Email: sklinski@orthopt.org

Editor
Christopher Hughes, PT, PhD, OCS

Book Review Editor
Michael Wooden, PT, MS, OCS

Publication Title: *Orthopaedic Physical Therapy Practice* Statement of Frequency: Quarterly; January, April, July, and October
Authorized Organization's Name and Address: Orthopaedic Section, APTA, Inc., 2920 East Avenue South, Suite 200, La Crosse, WI 54601-7202

Orthopaedic Physical Therapy Practice (ISSN 1532-0871) is the official magazine of the Orthopaedic Section, APTA, Inc.

Orthopaedic Physical Therapy Practice is indexed by Cumulative Index to Nursing & Allied Health Literature (CINAHL) and EBSCO Publishing, Inc.

Officers

President:
Stephen McDavitt, PT, DPT, MS, FAAOMPT
Saco Bay Physical Therapy–Select Medical
55 Spring St Unit B
Scarborough, ME 04074-8926
207-396-5165
scfmpt@earthlink.net
Term: 2013-2019

Vice President:
Gerard Brennan, PT, PhD
Intermountain Healthcare
5848 South 300 East
Murray, UT 84107
gerard.brennan@imail.org
Term: 2011-2017

Treasurer:
Kimberly Wellborn, PT, MBA
604 Glenridge Close
Nashville, TN 37221
615-465-7145
wellborn@comcast.net
Term: 2015-2018

Director 1:
Aimee Klein, PT, DPT, DSc, OCS
1209 E Cumberland Ave Unit 1603
Tampa, FL 33602
813-974-6202
Aklein1@health.usf.edu
Term: 2015-2018

Director 2:
Duane "Scott" Davis, PT, MS, EdD, OCS
412 Blackberry Ridge Drive
Morgantown, WV 26508-4869
304-293-0264
dsdavis@hsc.wvu.edu
Term: 2016-2019

Office Personnel

(608) 788-3982 or (800) 444-3982

Terri DeFlorian, Executive Director
x2040 ..... tdeflorian@orthopt.org
Tara Fredrickson, Executive Associate
x2030 ..... tfred@orthopt.org
Leah Vogt, Executive Assistant
x2090 ..... lvogt@orthopt.org
Sharon Klinski, Managing Editor
x2020 ..... sklinski@orthopt.org
Brenda Johnson, ICF-based CPG Coordinator
x2130 ..... bjohnson@orthopt.org
Carol Denison, ISC Processor/Receptionist
x2150 ..... cdenison@orthopt.org

Chairs

MEMBERSHIP
Chair:
Renata Salvatori, PT, DPT, OCS, FAAOMPT
889 1 Belle Rive Blvd
Jacksonville, FL 32256-1628
904-854-2090
Nata.salvatori@gmail.com
Term: 2013-2018

Members: *Trent Harrison, William Kolb, Christine Becks (student), Thomas Fliss, Megan Poll*

EDUCATION PROGRAM
Chair:
Nancy Bloom, PT, DPT, MSOT
23 Brighton Way
St. Louis, MO 63105
314-286-1400
bloomn@wustl.edu
Term: 2016-2019

Vice Chair:
Emmanuel "Manny" Yung, PT, MA, DPT, OCS
Term: 2016-2019

Members: *Neena Sharma, Valerie Spees, Cuong Pho, John Heick*

INDEPENDENT STUDY COURSE & ORTHOPAEDIC PRACTICE
Editor:
Christopher Hughes, PT, PhD, OCS
School of Physical Therapy
Slippery Rock University
Slippery Rock, PA 16057
(724) 738-2757
chrisjhughes@consolidated.net
Term ISC: 2007-2019
Term OP: 2004-2019

ISC Associate Editor:
Gordon Riddle, PT, DPT, ATC, OCS, SCS
gordoncriddle@hotmail.com

Managing Editor:
Sharon Klinski
(800) 444-3982, x2020
sklinski@orthopt.org

PUBLIC RELATIONS/MARKETING
Chair:
Mark Shepherd, PT, DPT, OCS, FAAOMPT
555 Brightview Dr
Millersville, MD 21108
(703)527-9557
mhshepherd@gmail.com
Term:2015-2018

Vice Chair:
Kimberly Varnado, PT, DPT, FAAOMPT, OCS
Term: 2014-2017

Members: *Tyler Schultz, Kimberly Varnado, Carol Courtney, Jared Burch (student)*

RESEARCH
Chair:
Dan White, PT, ScD, MSc, NCS
STAR Health Sciences Complex
540 S College Ave, Ste 210L
Newark, DE 19713
dkw@udel.edu
302-831-7607
Term: 2016-2019

Vice Chair:
Amee Seitz PT, PhD, DPT, OCS
Term: 2016-2019

Members: *Michael Bade, Justin Beebe, Chad Cook, Jo Armour Smith, Rogelio Coronado*

ORTHOPAEDIC SPECIALTY COUNCIL
Chair:
Derrick Sueki, PT, DPT, OCS
13341 Garden Grove Blvd, Suite B
Garden Grove, CA 92843
714-750-4097
derricksueki@yahoo.com
Term: Expires 2017

Members: *Manuel "Tony"Domenech, Hilary Greenberger, Grace Johnson, Pamela Kikillus*

PRACTICE
Chair:
Kathy Cieslak, PT, DSc, OCS
3495 Hidden Lanes NE
Rochester, MN 55906
(507) 293-0885
cieslak.kathryn@mayo.edu
Term 2015-2018

Members: *Joseph Donnelly, James Spencer, Marcia Spoto, Mary Fran Delaune, Mike Connors, Elizabeth Bergman-Residency Fellowship*

FINANCE
Chair:
Kimberly Wellborn, PT, MBA
(See Treasurer)

Members: *Doug Bardugon, Penny Schulken, Judith Hess*

AWARDS
Chair:
Gerard Brennan, PT, PhD
(See Vice President)

Members: *Karen Kilman, Emily Slaven, Marie Corkery, Murray Maitland*

JOSPT
Editor-in-Chief:
J. Haxby Abott, DPT, PhD, FNZCP
University of Otago
Dunedin, New Zealand
haxby.abbott@otago.ac.nz

Executive Director/Publisher:
Edith Holmes
edithholmes@jospt.org

NOMINATIONS
Chair:
James Spencer, PT, DPT, CSCS
PO Box 4330
Aspen, CO 81612
781-856-5725
James.spencer.pt@gmail.com
Term: 2014-2017

Members: *Judy Woerhle, Carol Courtney*

APTA BOARD LIAISON –
Susan Appling, PT, DPT, PhD, OCS, MTC

2015 House of Delegates Representative –
Kathy Cieslak, PT, DSc, OCS

ICF-based CPG Editor –
Joe Godges, PT, DPT, MA, OCS
Term: 2008-2017

ICF-based CPG Revisions Editor –
Christine McDonough, PT, PhD

SPECIAL INTEREST GROUPS

OCCUPATIONAL HEALTH SIG
Lorena Pettet Payne, PT, MPA, OCS–President

FOOT AND ANKLE SIG
Chris Neville, PT, PhD–President

PERFORMING ARTS SIG
Annette Karim, PT, DPT, OCS, FAAOMPT–President

PAIN MANAGEMENT SIG
Dana Dailey, PT, PhD–President

IMAGING SIG
Charles Hazle, PT, PhD–President

ANIMAL REHABILITATION SIG
Kirk Peck, PT, PhD, CSCS, CCRT–President

EDUCATION INTEREST GROUPS
Manual Therapy – Kathleen Geist, PT, DPT, OCS, COMT
PTA – Jason Oliver, PTA
Residency – Matthew Haberl, PT, DPT, ATC, FAAOMPT, OCS

Editor's Note

Onward and Upward

Christopher Hughes, PT, PhD, OCS

I am not sure how many of you were at the general Membership Meeting at CSM but I presented an update on a technology initiative that had been mandated by the Board of Directors of the Orthopaedic Section.

Recently, the Board recognized the need to upgrade our independent study courses (ISCs) to a technology publishing platform to better serve members and keep "in step" with recent technological innovations in learning. As a result, we have established an exciting new partnership with the *Journal of Orthopaedic and Sports Physical Therapy* (*JOSPT*) to move our ISCs to the same publishing platform used by *JOSPT*. This partnership includes hosting services provided by one of the premier web hosts, Atypon Systems, Inc., and also use of another vendor, ScholarOne, which specializes in online manuscript submission and peer review services. Working with the wonderful *JOSPT* staff of Edith Holmes, Sarah Weathers, and Anthony Willard has allowed Managing Editor, Sharon Klinski and me to be mentored through this process as judiciously as possible.

This collaboration will provide a number of advantages for you, the member. For example, the platform will allow a more efficient administrative handling of the internal publishing process and ultimately pushing new courses to market in a timelier manner. Also authors and reviewers for the ISCs will be required to submit work through a more efficient online submission system provided by ScholarOne. Sharon and I have had the pleasure to work with some of the best in the field. We know it takes a great deal of time and energy to author a course and also to take a course. With our new ISC website, we will be able to deliver courses to the registrant across multiple platform devices (computer, tablet, smartphone). An expanded line of products using media rich formats is also being pursued. Also for those who like the traditional format, rest assured, printed monographs and courses are not going to disappear.

In order to pull this off, a number of back end preparations and migrations are occurring. Digital branding and cataloguing of our current library of ISCs are being completed so these courses can be viewed across multiple devices. We are developing new landing pages for easier browsing of courses and the ability to purchase ISCs on the new platform. We believe it is important to package our intellectual property in the best quality medium possible and represent our hard working authors in a professional manner. In addition, we want you, the purchaser of such content, to understand that we are interested in providing the greatest value to you in terms of time, money, and knowledge gained. We understand you have many options when seeking educational materials for professional development. Our strength has always been our grass roots motto of tapping into our members for the best products possible. In turn, your purchasing dollars go right back to you as a member. The profit gained is all yours and keeps Section dues down and ensures that the Section remains *the source* for Orthopaedic Physical Therapy.

Honestly, it is a great deal of work, but it is a natural next step to offer our members. We have some great ideas. Our next update will likely be in May at the Orthopaedic Annual Meeting in Atlanta, so stay tuned! In the end it is all about bringing you, the member, a better product…served the way you like it and with the same credible content that only the Section can provide. Despite the never ending challenges in health care, it is an exciting time to be involved with the Section. As always, it continues to be my privilege to serve the Section leadership and the wonderful members of the Orthopaedic Section!

Paris Distinguished Service Award Lecture

The Interaction of Research and Practice in Orthopaedic and Sports Physical Therapy

Guy G. Simoneau, PT, PhD
Professor, Department of Physical Therapy, Marquette University
Editor-in-chief, *JOSPT*, 2002-2015

The Paris Distinguished Service Award lecture was presented at the 2016 Combined Sections Meeting in Anaheim, CA this past February.

I would like to thank those individuals who coordinated my nomination for this award and wrote letters of support as well as the award committee for my selection. I am truly honored and humbled by this award, first for what it represents but also for whom it is named. Dr. Paris (*present in the audience)*, thank you for everything you have done and continue to do for the physical therapy profession. It is such an honor for me to receive this award, which bears your name.

Tonight, I would like to leverage my experience of the past 14 years as editor of a journal to share a few "big picture" observations of how a journal can serve the profession. Some of my comments may not be particularly novel, but I hope to offer insights from a slightly different perspective.

I have been to Anaheim only twice in my life. The first time was in June 2001 to interview for the position of editor-in-chief of *JOSPT*. The second time is this week—closing the loop on 14 years as editor-in-chief. So, after receiving the great news about the Paris Award, I could not help but look back at how I got to Anaheim the first time.

Clearly the pivotal moment of my career was attending the University of Illinois in Champaign-Urbana—a decision reached through 10% planning and 90% random events and pure luck. The planning part took place during my final year of physical therapy school in Montreal in Canada when I was applying to schools in the United States with the goal to study sports medicine and athletic training. Because this was before the Internet, the process of applying to grad school was a bit tedious: I had to walk to a small office on campus, look at paper flyers pinned to a wall display, and send letters by mail. During that same period of time, the owner of a private practice where I was doing a clinical affiliation asked me to join his practice after I graduated. When I told him that I could not accept his offer and that I was applying to grad school, he told me about a long-time acquaintance of his, a former college football player who was now a physician and the head of a sports medicine program at a school in the United States. This incredible randomness of events led me to apply to the physical education program of the University of Illinois in Champaign-Urbana. And, as it turned out, it is the only school that ever replied to my applications. The combination of that particular clinician and that five-minute conversation is probably the single event, in the chaos of life, that had the biggest impact on my professional career. As if this was not enough, the lucky part of the equation can be directly attributed to a person I never actually met, Dr. Tim Nugent, who years before had founded a program at the University of Illinois in Champaign-Urbana to provide accessibility to education to individuals with disabilities; he was light-years ahead of his time. A graduate student with a background in physical therapy was a perfect fit for their program.

After the University of Illinois and a few years in the clinic and teaching, my next stop was Penn State University, working with Dr. Peter Cavanagh, a brilliant researcher who could take the most trivial as well as the most complex topic and present it in a way that was completely new and enlightening. I spent 4 years in Dr. Cavanagh's lab, and I learned a great deal.

So by the time I went to Marquette University as a faculty member, I was really an outsider to the physical therapy profession in the United States because I had gone to a physical therapy school in Canada and did my masters and PhD work in schools without physical therapy programs. Yet, out of nowhere, a few years later, Dr. Rick Di Fabio—someone I had never met or talked to before that moment—called to ask if I was interested in being an associate editor for *JOSPT*. His offer was based on having read some of the reviews I had done for the *Physical Therapy Journal* when he was one of their associate editors. Three years later I was applying to be editor-in-chief.

It took a fair bit of luck and randomness to get to Anaheim the first time, and it took a few key people who were willing to take a chance on me. I am very thankful for the initial opportunity to study and then work in the United States and to eventually become editor-in-chief of *JOSPT* when most people probably had no idea who this "guy" was.

While looking through some old files on my computer to prepare for this talk, I came across two letters, both dated August 31, 2001. I had completely forgotten that these letters existed. One was a four-page letter detailing all of the challenges related to the *Journal* at the time and why taking the editor position was probably a very bad idea. The other was a one-page letter letting the board of directors know that I was accepting the position. As with many decisions in life, the correct decision—in this case, accepting the position of editor-in-chief—was not the particularly obvious one.

Receiving the Paris Award today is clearly related to my time with the *Journal*, and I need to recognize the many people who contributed to this amazing journey over the past 14 years.

First, the engine behind the *Journal* has clearly been the dedicated team in the *JOSPT* office. These individuals (Edith Holmes, Jan DiVincenzo, Sarah Weathers, Anthony Willard, Corey Parker, Anthony Gauslin, and Tony Calamaro) have been key in moving the *Journal* into the digital age as well as redesigning the look of the *Journal*. In addition, they played a vital role in an initiative that was very important to me, making the *Journal* more accessible to members of other orthopaedic, sports, and manual physical therapy groups. It has been a rewarding experience to travel to conferences and meet people from many of those countries stopping by the *JOSPT*

booth just to say hello and tell us how much they appreciated having access to the *Journal*.

The team in the *JOSPT* office was also key in expanding the *Journal's* interaction with and exposure to the medical profession, especially through our collaboration with the *Journal of Bone and Joint Surgery (JBJS)*. First with the production of two special reports highlighting the teamwork between the two professions, followed by four hugely successful webinars produced over the past two years, and finally, the more recently initiated monthly article exchange between the two journals. The twice-a-year webinar series as well as the monthly article exchange is an ongoing collaboration. This is an area where I believe we have a lot more work to do: making other professions better aware of our clinical and research capabilities.

During these 14 years as editor-in-chief I also had the privilege to work with a talented team of associate editors who were truly the brains behind the operation. I learned an incredible amount from each of them, and I am grateful they had enough confidence in the *Journal* to accept my invitation to be part of the editorial team.

Through their work, we created new features that addressed very specific needs for the profession. The *Patients Perspective* was designed to better educate the general population on what physical therapy has to offer. The *Musculoskeletal Imaging* feature was designed to assist the physical therapy profession in the transition to direct access, and I am told that some of those published cases are today used in training programs for radiologists, furthering the exposure of our clinical expertise to another professional group. Finally, the clinical practice guidelines have been a huge contribution to the field, with the orthopaedic section, with some assistance of the *Journal*, deserving most of the credit for this feature.

As international collaborations were created and new features developed, we have seen a steady increase in online access to the *Journal,* with the peak in activity coinciding with release of the *Journal* each month, suggesting access from clinicians, hopefully contributing to their lifelong learning and the quality of care provided to patients. Nearly 1.2 million visits were made to the *JOSPT* website this year.

None of this happens without a huge contribution from authors and reviewers, and to those people I say a huge thank you for your work and dedication.

What is the research landscape today? From my perspective related to the *Journal*, I suggest that we have continued growth and expansion of high-quality, multi-disciplinary research, arising from a great diversity of countries. It is noteworthy that, based on impact factor, we currently have three physical therapy journals—*JOSPT*, *PTJ*, and the *Journal of Physiotherapy*—ranked in the top tier of journals in rehabilitation, orthopedic, and sport sciences. Having highly ranked physical therapy journals is important, as professional journals can be a very visible asset to a profession's perceived clinical and research credibility.

For clinically-oriented journals, the challenge is to maintain a high impact factor while still publishing papers across the full spectrum of evidence, therefore ensuring publication of material of direct clinical relevance to clinicians and clinical practice. The hugely popular special issue on tendinopathy published last November in *JOSPT* is only one more reminder of that goal.

Stepping back and looking at the big picture, everything I have talked about tonight is related to how a professional journal can help meet the following expectations of patients and society: to provide optimal health care, to empower patients to achieve optimal function, and do so in a cost-efficient manner. And from meeting physical therapists, in

many and diverse countries, these goals appear to be the same for everyone.

It is interesting to consider how we can best drive changes in physical therapy practice to achieve these goals. You could debate that one approach is through research; another approach is certainly through exposure to clinical expertise. This latter approach has historically been possible through a variety of continuing education options, and has more recently been somewhat better formalized through a growing number of fellowship and residency programs. I think it is probably a combination of both approaches that will work best, and yet both approaches are full of challenges for the clinician. On the research side: How do clinicians keep up with the literature, organize the information, and really sort out the signal from the noise? On the clinical expertise side: How do you attend all professional development courses, learn from every expert, and sort out the facts from fiction?

Stepping back one more time to look at the big picture, maybe part of the answer is going back to the basics and organizing information based on the four questions most patients have: What is the problem? Will it get better? What can be done? Any risks involved? This is nothing new, and in fact simply reflects evidence-based practice; the questions are related to diagnosis, prognosis, therapy, and harm.

Until relatively recently, diagnostic accuracy studies and terms such as sensitivity and likelihood ratio of a test were quite a novelty. I suspect it is no longer the case. And while potentially useful in some instances, it is clear that the diagnostic approach focused on pathophysiology has significant limitations. Accordingly, significant effort is currently being invested in the development of alternate diagnostic paradigms that are more reflective of what we do as physical therapists, and some of those efforts suggest that we may actually need to combine various paradigms to achieve greatest success with care.

A most exciting area of our recent research growth, at least to me, has been the effort to provide better evidence related to prognosis. This is an area of clinical implementation that is still relatively new to many physical therapists. How exciting would it be to have a better idea of who may or may not respond to treatment for common pathologies such as hip osteoarthritis? Similarly, what if we could readily identify the 50% to 70% of people only requiring minimal care and health care dollars after a motor vehicle collision and immediately target the more extensive clinical interventions toward those 30% to 50% of patients post-whiplash who are likely to continue to have significant disability long-term? In high-performance athletes, what if we could better identify predictors of recovery time for common conditions such as hamstring injuries? The same could be said for better mapping of recovery following many common surgeries or injuries.

Better prognostic tools have the potential to stratify delivery of care, as recently shown by the use of the STarT Back screening tool. On one end of the spectrum, it may help identify people who only need minimal care, reducing unnecessary testing or treatment procedures and the resulting waste of health care dollars. At the other end of the spectrum, it could also help identify early on those patients who would benefit from a cognitive behavioral intervention as part of their overall plan of care. Stratification of care—providing the right treatment to the right person at the right time—is a critically important conceptual advance to physical therapy care, not only to identify those needing more care, but also to identify those currently receiving unnecessary care.

And the research group from Keele University in England has recently provided evidence to support stratification of care in individuals with low back pain. In a large pragmatic randomized controlled trial of more than 800 patients, they showed that those individuals treated based on the stratification approach had better short- and long-term improvement for fewer health care dollars. This is the holy-grail of outcomes for countries with socialized medicine.

There are many reasons to believe that we have only seen the beginning of physical therapy research related to interventions. Research is being performed with increasingly more refinement, with larger numbers of participants, and by leveraging clinical information from large databases. At the same time that we are seeing more sophisticated clinical trials, we are also seeing increasingly more sophisticated basic science and mechanistic studies, with the potential for significant impact on how we treat conditions.

Many of those changes are driven in part by standards of research that have only recently emerged, which include a growing understanding of design of clinical trials—trials that should be predicated on achieving specific goals related to either optimizing results of an intervention, as best tested through explanatory trials, or providing care in a more pragmatic manner reflective of the health care environment. Both approaches have their advantages and disadvantages, with most studies falling somewhere in between the extremes.

We are also starting to see novel research designs using "refresher" or "booster" sessions for chronic conditions. Maybe we have to switch the long-held physical therapy mindset that, after an episode of care, we need to send patients away with the goal of never seeing them again for the same condition. Seeing patients on a regular or periodic basis over a long period of time may not actually be "failure" of physical therapy care but simply exactly what is indicated for some conditions or individuals.

As a profession, we are proud of the fact that most of what we do is considered low risk, and yet, risks cannot be ignored. In fact, maybe risk is increased by what is not done as opposed to what is done. What if an intervention that could have made a difference is not provided?

From my perspective, based on the quality of the work published in *JOSPT* and other journals over the past 14 years, both clinical and research papers, the physical therapy profession has a lot to be proud of. We have come a long way in a short time. One challenge to continued growth, in my opinion, is in the area of mentorship, providing opportunities to promising clinicians and researchers to develop to their full potential.

As we contemplate the complexity of clinical decision making, which involves a combination of clinical experience, patient values and expectations, and evidence, applied within the context of a healthcare system, I remain convinced that professional publications can play an important role in this process. I believe that the last 14 years of *JOSPT* have served that purpose both here in the United States as well as internationally.

In closing, in addition to all of those I have already acknowledged tonight, there is one last group to whom I need to extend my gratitude, and that is to the leadership of both the Orthopaedic and Sports Physical Therapy Sections along with the members of the Board of Directors of *JOSPT* for their continued support of the *Journal* and its growth over the years.

A Comparison of Lower Extremity Alignment Risk Factors Between Competitive and Recreational Runners

Michael Bade, PT, DPT, PhD[1]
Stephanie Baertlein, PT, DPT[1]
Trevor Bouten, PT, DPT[1]
Kyle Conboy, PT, DPT[1]
Anne Kim, PT, DPT[1]
Michael Van Portfliet, PT, DPT[1]
Ethan Young, PT, DPT[1]
Steven Vasquez, PT, DPT[1]
Thomas McPoil, PT, PhD[1]

[1]*School of Physical Therapy, Regis University, Denver, CO*

ABSTRACT

Background: Although no one specific variation in lower extremity alignment or muscle strength and flexibility has been shown to be a major risk factor in the development of overuse running-related injuries, several authors have reported that a difference in leg length, hip joint range of motion, as well as hamstring and calf muscle flexibility or strength deficits can be potential overuse injury risk factors in distance runners. **Purpose:** The purpose of our study was two-fold. First to determine the intrarater reliability of the measurements to assess leg length inequality, hip joint rotation range of motion, hamstring and calf plantar flexor flexibility, as well as hip abduction and calf plantar flexor muscle strength. Our second purpose was to determine if differences in these measurements of alignment, flexibility, and strength existed between collegiate cross-country runners and recreational runners. **Methods:** Ten collegiate and 10 recreational runners participated in the study. Subjects were excluded if they had a history of lower extremity injury in the past 3 months or a prior injury/congenital deformity that caused a change in bony alignment of the leg and foot. All runners averaged at least 18 miles per week of running over the past year. All runners were evaluated on the following measures: leg length in standing and supine, hip internal and external range of motion in prone, calf flexibility (with knee extended and flexed), hamstring flexibility, calf plantar flexor strength, and hip abduction strength, by 5 different novice raters. To assess intrarater reliability, subjects were evaluated twice, one week apart, by the same rater. **Results:** Measurement reliability ranged from excellent to substantial for all measurements except calf plantar flexor strength, which was fair. The percent agreement for the assessment of leg length in standing was 100%. There were no significant differences between the two groups of runners for any of the measurements assessed. **Conclusion:** Based on the findings of this study, the clinician can be confident using the measurements of leg length, hip joint rotation range of motion, flexibility of the hamstrings and calf muscles, as well as the strength of the calf and hip abductor muscles, described in this study when performing an examination of a runner with an overuse injury or when conducting a pre-season screening of distance runners.

Key Words: measurement reliability, lower extremity alignment, strength, flexibility, running

INTRODUCTION

Running is one of the most popular physical activities in the world. Although running is an activity that almost anyone can perform, the risk of injury can be quite high with the incidence varying from 19% to 79%.[1] While acute injuries are rare, limited to muscle/tendon strains and joint sprains, approximately 80% of running-related injuries are associated with overuse.[1] Numerous risk factors have been associated with running-related overuse injuries and have been categorized by van Gent et al[2] as: (1) systemic factors (age, gender, height, weight, alignment, strength, flexibility), (2) running/training related factors (training frequency, alterations, distance, surface, and shoe use) (3) health factors (previous injury, medical history, and (4) lifestyle factors (drinking, eating habits, smoking, other sport activities). Since the etiology of running-related injuries has been shown to be multifactorial, it is critical that the clinician have an awareness of all associated risk factors when examining the distance runner who presents with an overuse injury. Pre-examination questionnaires as well as the history can be used to gain insight related to risk factors associated with running/training, health, and lifestyle. However, various tests and measures are often necessary to determine alignment variations as well as strength and flexibility deficits attributed to systematic-related risk factors. Wen et al conducted one of the first studies that attempted to prospectively study the effect of skeletal alignment in distance runners.[3] In their study, they assess over 300 runners enrolled in a 32-week marathon-training program. They reported that minor variations in alignment did not appear to be major risk factors in the development of overuse injuries in runners. However, one drawback to this study is that the authors failed to assess reliability for any of the measurements they used in their study. More recent systematic reviews of past research have reported that the effect of lower extremity alignment, and deficits in muscle strength and flexibility on the development of overuse running injuries are inconclusive and stress the need for better-designed prospective studies.[1,2,4]

Although no one specific variation in lower extremity alignment or muscle strength and flexibility has been shown to be a major risk factor in the development of overuse running-related injuries, several authors have reported that a difference in leg length, hip joint range of motion (ROM), as well as hamstring and calf muscle flexibility or strength deficits can be risk factors for overuse injury in distance runners. While Rauh et al[5] reported no relationship between overuse injuries and leg length discrepancy in a group of high school runners, Korpelainen et al[6] reported that leg length discrepancy was associated with stress fractures in long-distance runners. A recent systematic review by Carvalho et al[7] also reported that a leg length discrepancy of more than 10 mm was associated with running-related injuries. Burne et al[8] and Newman et al[9] have both reported that increased external rotation of the hip joint was associated with an increased risk of developing medial tibial stress syndrome in both military recruits and in runners. Rabin et al[10] have reported that limited ankle dorsiflexion ROM is related to an increase in Achilles

tendinopathy in infantry recruits undergoing basic training, and Messier et al[11] found that decreased hamstring flexibility was related to larger knee joint loads in runners. The need to assess calf muscle strength would appear to be important since this muscle group can act as a shock attenuator during running. In their clinical commentary, Warden and colleagues[12] stressed the importance of calf plantar flexor muscle strength in preventing bone stress injuries in runners. Finally, Fredericson et al and Niemuth et al have reported that weakness in the hip abductor muscles of distance runners can be a factor in the development of overuse injuries, such as iliotibial band syndrome.[13,14]

Based on a review of these studies, it seems prudent for the physical therapist when performing an evaluation or prescreening exam of a distance runner with an overuse injury to include reliable measurements of leg length, hip joint rotation ROM, flexibility of the hamstrings and calf muscles, as well as the strength of the calf and hip abductor muscles. While previous literature has used these measurements on various cohorts (ie, healthy non-runners, individuals training for a marathon, and experienced runners), we found no previous studies that compared measurements of skeletal alignment, flexibility, and strength between intercollegiate cross-country runners and recreational runners.

Thus, the purpose of our study was two-fold. First to determine the reliability of the measurements to assess leg length inequality, hip joint rotation ROM, hamstring and calf plantar flexor flexibility, as well as hip abduction and calf plantar flexor muscle strength. Our second purpose was to determine if differences in these measurements existed between collegiate cross-country runners and recreational runners. We hypothesized that: (1) no differences would exist between collegiate and recreational runners for the measurements of alignment and flexibility since both groups were symptom-free and running at least 18 miles per week at the time of data collection, and (2) collegiate runners would demonstrate greater hip abduction and ankle plantar flexion strength in comparison to the recreational runners, since the collegiate runners were required to participate in a weekly team-required weight-training program.

METHODS

Participant Characteristics

Ten collegiate Division II runners (7 women and 3 men) were recruited from the Regis University cross country team and 10 recreational runners (7 women and 3 men) were recruited from Regis University and surrounding communities to participate in this study. Recreational runners were informed of the study through the use of community advertisements and public information sessions. All runners selected for the study met the following inclusion criteria: (1) between the ages of 18 to 40 years, (2) ran at least 18 miles per week for one year prior to participation in the study, (3) no previous history of lower extremity congenital or traumatic deformity or previous surgery that resulted in altered bony alignment, and (4) no acute or chronic injury 3 months prior to the start of the study that led to an inability to run at least 3 consecutive days during that time. The Institutional Review Board of Regis University approved the study protocol and all participants provided written informed consent prior to participation in the study.

Procedures

Upon arriving to the testing center, each subject's height and weight were recorded. Next each subject went to 5 different stations, each station manned by a different rater, to have the following measurements assessed and recorded.

Difference in leg length

Two procedures were used to assess leg length equality with the first method adopted from the protocol used by Jonson and Gross.[15] This method required the patient to be positioned in standing with their bare feet shoulder width apart and knees fully extended. A custom-made leveling device was positioned so that the arms of the device were resting on both iliac crests. A Torpedo level was positioned on the leveling device (Figure 1). If the device was not level, 3 mm shims were placed under the shorter leg until the Torpedo level was zeroed. The short leg and number of shims used to level the device were recorded. The second leg length assessment performed was the direct method as described by Brady et al.[16] This measurement was done in supine using a tape measure (Figure 2). Once positioned in supine, the subject was instructed to perform a bridge to clear the pelvis from the table, return the pelvis to the table, and then to relax their legs on the table. The rater then placed a mark just inferior to the medial malleolus bilaterally. The distance was measured by placing the tape on the ASIS to the mark created below the medial malleolus while ensuring the tape is positioned on the medial side and not on top of the knee joint. For both methods, subjects were classified as having a leg length difference if they had a leg length difference of greater than 5 mm as this has been shown to be the minimally detectable difference using these methods.[16]

Figure 1. Use of leveling device to assess leg length difference in standing.

Hip joint rotation range of motion

To quantify hip internal rotation (IR) and external rotation (ER) ROM, raters used the procedure derived from Berryman-Reese & Bandy.[17] Each subject was positioned in prone on a treatment table with a strap placed across the middle of the buttock. The knee to be measured was flexed to 90° and the opposite leg was slightly abducted. The subject was asked to actively externally and internally rotate his her hip as far as possible. Prior to testing, the subject's leg was positioned so it was perpendicular to the table so that the digital inclinometer (Pro 360 Digital Protractor, Mitutoyo America Corp, Aurora, IL) could be placed just superior to the lateral malleolus and zeroed. To assess internal rotation, the subject was instructed to rotate his leg outward as far as possible while keeping the knee flexed to 90° as far as possible (Figure 3). When the subject indicated that they had internally rotated the leg

Figure 2. Use of tape measure to assess leg length in supine.

Figure 3. Use of digital inclinometer to measure hip internal rotation.

as far as possible, the angle was measured and recorded. To assess external rotation, the subject was instructed to rotate his leg inward as far as possible while keeping the knee flexed to 90° as far as possible. When the subject indicated that they had externally rotated the leg as far as possible, the angle was measured and recorded. The measurements were taken on the left and right extremities.

Calf flexibility

The flexibility of the calf muscle/tendon structures was assessed in weight bearing using the ankle dorsiflexion lunge test adapted from a method described by Barton et al.[18] Prior to assessing calf flexibility, each subject was asked to perform two standing 30-second stretches with the knee of the leg to be measured fully extended. A 10-second rest period was given between the two stretches. This was followed by two 30-second stretches with the knee of the leg to be measured flexed approximately 25°. A 10-second rest period was again provided between the two stretches. The subject was then positioned on a measurement board with his feet placed 13 cm apart. To measure maximum ankle dorsiflexion with the knee extended, the subject performed a weight bearing forward lunge with the knee of the leg being measured fully extended. To maintain balance during the measurement, the subject was allowed to touch the wall with his fingers. To ensure that the heel did not leave the measurement board during the forward lunge, an index card was placed under the heel between the medial malleolus and the most posterior aspect of the heel. During the forward lunge, the rater pulled on the index card to ensure that the heel did not rise off the board. When the subject indicated they had moved forward as far as possible without lifting his heel from the board, a digital inclinometer was placed at the distal aspect of the tibial tubercle and the angle recorded (Figure 4). The subject was then asked to return to the starting position and to perform the forward lunge with the knee-extended again so a second measurement could be recorded. Once completed, the subject was then asked to repeat the same procedure so that calf flexibility with the knee of the leg to be measured flexed approximately 25° could be measured twice. The assessment of calf flexibility was performed on both the left and right extremities.

Hamstring flexibility

To assess flexibility hamstring muscle/tendon structures, the knee extension angle method described by Davis et al was used.[19] To perform the knee extension angle method, the subject was positioned in supine on a treatment table and a gravity inclinometer (Mecklenburg-Duncan, Oklahoma City, OK) attached to a Velcro strap was placed just superior to the patella of the thigh of the leg being tested to ensure that the thigh was maintained in flexed 90° during the measurement. The subject was then asked to extend his knee actively as far as possible until he experienced a strong tolerable stretch, twice as a pre-measurement warm-up. The subject was then asked to extend his leg a third time and when the subject indicated he had moved the leg as far as possible, the rater supported the subject's leg while placing a digital inclinometer on the anterior border of the tibia just inferior to the tibial tubercle to recorded the angle (Figure 5).

Calf plantar flexor and hip abduction strength

The strength of the plantar flexor muscles was tested using a standing heel-rise test described by Madeley et al.[20] When performing the test, calf strength was determined by counting the number of total maximum heel raises the subject could perform not counting the attempts in which the top of the foot did not touch the cord of the custom-made completion monitor (Figure 6). Prior to testing, the subject was asked to perform a heel raise as high as possible so that the elastic cord of the completion monitor could be positioned so that it was touching the top of the dorsum of the foot being tested. Once the cord was

Figure 4. Assessment of calf flexibility with knee extended.

Figure 5. The assessment of hamstring flexibility using the knee extension angle method.

positioned, the subject was instructed to flex the knee of the leg not being testing and perform as many calf raises as possible while keeping the leg being tested extended (Figure 7). The subject was allowed to touch the wall to maintain his balance during testing. Only those heel raises in which the dorsum of the foot touched the cord were included in the total number of heel raises. Measurements were recorded for both the left and right lower extremities.

The strength of the hip abductors was assessed with the subject in a sidelying position on a treatment table using the protocols described by Ireland et al and Bolgla et al.[21,22] Prior to testing, the distance between each subject's greater trochanter and the lateral femoral condyle was measured with a tape measure to determine an estimate of the femoral length of the leg to being tested. The subject's pelvis was secured to the table using a strap. The lower extremity being tested was then abducted 10° using pillows and a second strap was placed around the proximal aspect of the lateral femoral condyle to stabilize a hand-held dynamometer (Micro-FET2, Hogan Scientific LLC, Salt Lake City, UT) that was positioned between the leg and the strap (Figures 8 and 9). After a practice trial, the subject was asked to abduct his leg with maximal effort. Three maximum voluntary isometric contractions (MIVC) were recorded. A 30-second rest period was provided between each MIVC. The measurements were performed on both the left and right lower extremities. To normalize hip strength among subjects, the average of the 3 MIVC was divided by femoral length.

Reliability Determination

To establish intrarater reliability for the measurements used in this study, 5 raters were asked to assess 10 randomly selected participants who were not runners. Each rater was assigned to a specific station so they would perform the same measurements at each station for both the reliability determination and runner assessment portions of the study. The 5 raters were second year doctor of physical therapist students who were provided one-hour of training by 2 instructors, followed by a single one-hour practice session. Each rater then performed the same measurements at each station on each of the 10 participants over 2 different testing sessions with at least one week between the 2 testing sessions. Each rater performed and recorded his or her own measurements (not blinded) during each testing session. For this study, only intrarater reliability was

Figure 6. Placement of the elastic cord of the completion monitor used to assess calf plantar flexor strength.

Figure 7. Subject performing heel raises on the completion monitor.

assessed. The assessment of reliability for all 5 raters was performed on the measurements recorded for the right extremity only.

Statistical Analysis

Intraclass correlation coefficients (ICC) were calculated to determine the consistency of each rater to repeatedly perform the measurements (intrarater; ICC3,1) between two test sessions one week apart. The level of reliability for the ICC was classified using the characterizations reported by Landis and Koch.[23] These characterizations were: *slight*, if the correlation ranged from 0.00 to 0.20; *fair*, if the correlation ranged from 0.21 to 0.40; *moderate*, if the correlation ranged from 0.41 to 0.60; *substantial*, if the correlation ranged from 0.61 to 0.80; and *almost perfect*, if the correlation ranged from 0.81 to 1.00. In addition to ICC values, the Standard Error of the Measurement (SEM) was also calculated as another index of intrarater reliability. The SEM is in the same units as the original measurement and represents how the measurements would vary if measured more than once by each rater.[24] In addition to descriptive statistics, a series of t-tests were performed to determine if differences existed between the left and right extremities for the cross-country and recreational runners. The level of agreement for the rater assessing leg length discrepancy was determined using the Kappa coefficient.[25] Because of the multiple comparisons conducted using t-tests, an alpha level of 0.10 was established for all tests of significance to avoid possible type I error. The SPSS, version 22 (IBM Statistics, New York, NY) was used for all statistical analyses.

RESULTS

The intrarater ICC and SEM values for testing sessions 1 and 2 for all raters are listed in Table 1. The ICC values for all raters ranged from 0.40 to 0.97 and the standard error of the measurement ranging from 1.1 to 7.54 for test session 1 and from 1.1 to 8.93 or test session 2. Based on the ICC classification scheme proposed by Landis and Koch, the measurements of hip external rotation, ankle dorsiflexion knee extended, ankle dorsiflexion knee flexed, hamstring flexibility, and hip abduction strength would be classified as *almost perfect*. In addition, the measurement of hip internal rotation would be classified as *substantial*, while plantar flexor strength would be classified as *fair*. The SEM values for the measurements of hip external rotation, ankle dorsiflexion knee extended, ankle dorsiflexion knee flexed, and hamstring flexibility ranged from 5% to 10%. For hip internal rotation, hip abduction strength, and calf plantar flexor strength ranged from 12% to 25%.

For the rater evaluating leg length discrepancy, the percent agreement between day 1 and day 2 for the measurement in standing 100% (Kappa = unable to calculate as no variance) and for the measurement in supine 60% (Kappa = 0.2). Based on the results of the Kappa statistic, only the standing assessment of leg length was used for between group comparisons.

The mean age (in years), body mass index (BMI) and weekly mileage distance for the collegiate runners was 19, 21.2, and 50.5, respectively. The mean age (in years), BMI, and weekly mileage distance for the recreational runners was 26, 21.7, and 25.2, respectively. While the intent of the study was to match by gender the cross-country and the recreational runner groups, t-tests indicated that age ($p > .0001$) and mileage ($p > .0001$) between the two groups of runners were significantly different. There was no significant difference between the two groups for BMI ($p > 0.51$).

Means and standard deviations for the 7 measurements for the left and right extremities are listed in Tables 2 and 3. The results of t-tests between the left and right extremities for all 7 measurements (hip external rotation, hip internal rotation, ankle dorsiflexion knee extended, ankle dorsiflexion knee flexed, calf muscle strength, hamstring flexibility, and hip abduction strength) were not significant between the two groups of runners. There was no difference in leg length between the two groups of runners using the standing assessment method.

DISCUSSION

The intent of our study was two-fold. First, we wanted to determine the reliabil-

ity of clinically-based measurements used to assess leg length inequality, hip joint rotation range of motion, hamstring and calf flexibility, as well as hip abduction and calf plantar flexor strength performed by raters with minimal clinical experience. Our second purpose was to determine if differences in these measurements of alignment, flexibility, and strength existed between collegiate cross-country runners and recreational runners.

With regard to the first purpose of the study, our results demonstrated excellent levels of intrarater reliability for hip external rotation range of motion, ankle dorsiflexion knee extended, ankle dorsiflexion knee flexed, hamstring flexibility, and hip abduction strength. The intrarater reliability ICC values for all 5 of these measurements were ranged from 0.83 to 0.97. While the ICC value for hip internal rotation was .78, the level of reliability was very close to the other 5 measurements that exceeded an ICC value of .80. These findings are in agreement with previously reported reliability values for these measurements. Barton et al found intrarater reliability for measuring standing ankle dorsiflexion (knee flexed) to have an ICC value equal to 0.90-0.95 and for standing ankle dorsiflexion (knee extended), the ICC is equal to 0.81-0.85.[18] Boyd et al used a similar method of measurement of hamstring length using a hand-held inclinometer reported almost perfect intrarater reliability (ICC values between 0.95-0.98).[26] Hip internal and external rotation measurements were performed based on the method described Berryman-Reese and Bandy.[17] One of the only studies that has investigated the reliability of the assessment of hip joint rotation range of motion in prone was performed by Simoneau et al.[27] While these researchers only assessed interrater reliability values, they reported ICC values between .76 and .98 for active hip joint rotation. It is interesting to note that in our study, the reliability level was higher for hip external rotation (ICC= .83) in comparison to hip internal rotation (ICC = .78). While we believe that these reliability values are adequate for clinical use, it is important to note that the two previous studies suggesting that hip rotation is a factor in the development of running-related overuse injuries have only implicated hip external rotation.[8,9] With regard to hip abduction strength, Fredricson et al measured the intrarater reliability of hip abduction in runners by using a hand-held dynamometer in sidelying with the assessor asking the patient to maintain a slightly abducted hip in an isometric strength assessment.[13] They reported

Figure 8. Positioning of subject for the measurement of hip abduction strength.

Figure 9. Placement of dynamometer to assess hip abduction strength.

Table 1. Intrarater Intraclass Correlation Coefficients, Standard Error of the Measure, Mean, and Standard Deviation Values for Testing Sessions 1 and 2

		Means & Standard Deviations		SEM	
MEASUREMENTS	ICC	Day 1	Day 2	Day 1	Day 2
Hip External Rotation	0.83	44.77 ± 10.45	45.21 ± 11.47	4.28	4.7
Hip Internal Rotation	0.78	43.42 ± 10.98	41.73 ± 6.85	5.21	3.25
Calf Flexibility - Knee Extended	0.93	55.62 ± 4.83	55.03 ± 4.7	1.25	1.22
Calf Flexibility - Knee Flexed	0.97	50.12 ± 5.94	49.17 ± 5.91	1.1	1.1
Hamstring Flexibility	0.88	68.0 ± 16.46	67.62 ± 15.39	5.77	5.4
Normalized Hip Abduction Strength	0.85	7.6 ± 3.55	7.93 ± 3.53	1.39	1.38
Calf Plantarflexor Strength	0.40	30.7 ± 9.72	39.0 ± 11.52	7.54	8.93

Abbreviations: ICC, intraclass correlation coefficients; SEM, standard error of the measure

Table 2. Measurement Means (Standard Deviations) for the LEFT Extremity

	Hip External Rotation	Hip Internal Rotation	Calf Flexibility (Knee Extended)	Calf Flexibility (Knee Flexed)	Hamstring Flexibility	Calf Plantarflexor Strength	Normalized Hip Abduction Strength
Collegiate Runners	46.7 (11.8)	35.6 (7.3)	61.3 (2.3)	50.5 (4.9)	62.9 (10.4)	40.6 (14.3)	1.3 (0.5)
Recreational Runners	43.1 (11.2)	40.1 (11.6)	55.5 (6.6)	48.1 (7.1)	64.4 (14.3)	41.1 (21.1)	1.5 (0.3)

Table 3. Measurement Means (Standard Deviations) for the RIGHT Extremity

	Hip External Rotation	Hip Internal Rotation	Calf Flexibility (Knee Extended)	Calf Flexibility (Knee Flexed)	Hamstring Flexibility	Calf Plantarflexor Strength	Normalized Hip Abduction Strength
Collegiate Runners	49.9 (10.4)	38.9 (5.1)	60.3 (3.7)	51.0 (5.6)	61.7 (9.2)	38.1 (15.3)	1.2 (0.5)
Recreational Runners	43.1 (10.8)	43.1 (9.0)	53.8 (6.9)	47.6 (7.9)	64.3 (15.3)	40.2 (24.9)	1.5 (0.3)

an ICC of 0.96, showing almost perfect reliability.[13] Technique improvements were made by Ireland et al, who used a hand-held dynamometer to test isometric hip abduction and external rotation strength, using a strap instead of the assessors upper extremity, in hopes of eliminating any tester strength bias on force output of the subject.[21] Ireland et al did not report reliability measures for this technique, but the addition of the strap was intended to reduce any bias of tester strength on the tester hip abduction strength. Using the method proposed by Ireland et al, the ICC value for the assessment of hip abduction strength in our study was .85, indicating "almost perfect" reliability.[21]

The one measurement that achieved less than an optimal level of intrarater reliability was calf muscle strength. Using the Landis and Koch classification scheme, this measurement only had a *fair* level of reliability in our study.[23] This level of reliability is quite low in comparison to the findings noted by Madeley et al who reported test-retest reliability values of .92 (0.43-0.99) and 0.99 (0.90-1.00) for a group of 10 subjects in both a control and medial tibial stress syndrome groups respectively.[20] Madeley et al used a metronome set to 60 beats per minute, which was intended to produce a standardized rest time between repetitions, thus allowing for more control at reducing the effect of fatigue. Our study did not include the use of a metronome that may have allowed for more variance between trials due to the ability to complete more repetitions while the gastrocnemius and soleus muscles were not fatigued. Another factor that may have contributed to a difference was that half of the participants in the Madeley et al study were classified to have a current MTSS injury, affecting pain perception during the test.[20]

As previously noted, we used percent agreement and the Kappa statistic to assess leg length equality in standing. For standing leg length discrepancy, there was 100% agreement between the same rater between session 1 and session 2, but we could not calculate the Kappa because of a lack of variance. For the supine assessment of leg length, there was only a 60% agreement between the same rater between session 1 and session 2 (Kappa = 0.20). Brady et al reported higher levels of intrarater reliability for the standing assessment of leg length.[16] Jonson and Gross also reported high levels of intrarater reliability using the same method used in our study for assessing leg length in standing.[15] The lack of agreement when measuring leg length in supine could be attributed to several factors including the need to identify and mark both proximal and distal bony landmarks on both extremities. As noted by Brady et al, the difficulty in finding the identical location on paired bony landmarks can result in 4 possible sources of measurement error.[16]

Our first hypothesis was that no differences would exist between collegiate and recreational runners for the measurements of alignment and flexibility. We based this hypothesis on the fact that all of the participants in our study were running at least 18 miles per week for the past year and that appropriate training for this distance without the development of an acute or chronic injury that led to inability to run at least 3 consecutive days for 3 months prior to the start of the study would require adequate flexibility and no substantial variations in alignment. Our results indicated that there were no significant differences between the collegiate and recreational runners for hip external rotation, hip internal rotation, ankle dorsiflexion knee extended, ankle dorsiflexion knee flexed, and hamstring flexibility. Based on these findings, we failed to reject our first hypothesis.

Our second hypothesis was that collegiate runners would demonstrate greater hip abduction and ankle plantar flexion strength in comparison to the recreational runners. Our results indicated that there were no significant differences between the collegiate and recreational runners for ankle plantar flexion (calf muscle) or hip abduction strength. We based this hypothesis on the fact that intercollegiate cross-country runners were running a greater amount of weekly mileage in comparison to recreational runners as well as participating in a weekly team-required weight-training program. While there was a significant difference in the weekly mileage with the intercollegiate runners averaging 50 miles per week in comparison to the recreational runners who averaged 25 miles per week, there were no significant differences in

either ankle plantar flexion (calf muscle) or hip abduction strength. Based on these findings, we failed to accept our second hypothesis. A possible reason for the lack of difference in strength between these two groups of runners could be the increased weekly training mileage required for the collegiate runners. Although we did have to collect data on the collegiate runners at the beginning of their competitive season, we did schedule this groups data collection session after a rest day and prior to running.

A limitation of our study was the small number of runners in both the intercollegiate and recreational groups. Possibly with a greater number of runners in each group we may have found significant differences between the two groups of runners in the alignment, flexibility, and strength measurements used in this study. Furthermore, the fact that none of the runners who participated in this study reported an overuse injury at the time of their participation makes any correlation between the measures assessed in this study and the development of an overuse injury speculative at best. Another limitation was the age of the runners in our study. Since the average age of the collegiate and recreational runners was 19 years and 26 years, respectively, the results of our study may not be applicable to older running populations.

CONCLUSION

We have comprehensively described 7 measurements of lower extremity alignment, flexibility, and strength that have been shown to have fair to high levels of intrarater reliability for this sample of runners. The lower extremity alignment, flexibility, and strength variables assessed in this study have all been shown to be potential overuse injury risk factors in distance runners. Based on the findings of this study, the clinician can be confident using the measurements of leg length, hip joint rotation range of motion, flexibility of the hamstrings and calf muscles, as well as the strength of the calf and hip abductor muscles, when performing an examination of a runner with an overuse injury or when conducting a pre-season screening of distance runners.

REFERENCES

1. Neilsen RO, Buist I, Parner ET, et al. Foot pronation is not associated with increased injury risk in novice runners wearing a neutral shoe: a 1-year prospective study. *Br J Sports Med*. 2014;9:440-447. doi: 10.1136/bjsports-2013-092202. Epub 2013 Jun 13.
2. Van Gent RN, Siem D, van Middelkoop M, van Os AG, Bierma-Zeinstra SMA, Koe BW. Incidence and determinants of lower extremity running injuries in long distance runners: a systematic review. *Br J Sports Med*. 2007;41:469–480; discussion 480. Epub 2007 May 1.
3. Wen DY, Puffer JC, Schmalzried TP. Injuries in runners: a prospective study of alignment. *Clin J Sport Med*. 1998;8:187-194.
4. Saragiotto BT, Yamato TP, Hespanhol Junior LC, Rainbow MJ, Davis IS, Lopes AD. What are the main risk factors for running-related injuries. *Sports Med*. 2014;44:153-1163. doi: 10.1007/s40279-014-0194-6.
5. Rauh MJ, Koepsell TD, Rivara FP, Margherita AJ, Rice SG. Epidemiology of musculoskeletal injuries among high school cross-country runners. *Am J Epidemiol*. 2006;163:151-159. Epub 2005 Nov 23.
6. Korpelainen R, Orava S, Karpakka J, Siira P, Hulkko A. Risk factors for recurrent stress fractures in athletes. *Am J Sports Med*. 2001;29:304-310.
7. Carvalho A, Junior L, Costa L, Lopes A. The association between runners' lower limb alignment with running-related injuries: a systematic review. *Br J Sports Med*. 2011;45(4):339.
8. Burne SG, Khan KM, Boudville PB, et al. Risk factors associated with exertional medial tibial pain: a 12 month prospective clinical study. *Br J Sports Med*. 2004;38:441-445.
9. Newman P, Witchalis J, Waddington G, Adams R. Risk factors associated with medial tibial stress syndrome in runners: a systematic review and meta-analysis. *Open Access J Sports Med*. 2013;4:229-241. doi: 10.2147/OAJSM.S39331.
10. Rabin A, Kozol Z, Finestone AS. Limited ankle dorsiflexion increases the risk for mid-portion Achilles tendinopathy in infantry recruits: a prospective cohort study. *J Foot Ankle Res*. 2014;7(1):48. doi: 10.1186/s13047-014-0048-3. eCollection 2014.
11. Messier SP, Legault C, Schoenlank CR, Newman JJ, Martin DF, DeVita P. Risk factors and mechanics of knee injury in runners. *Med Sci Sports Exerc*. 2008;40:1873-1879. doi: 10.1249/MSS.0b013e31817ed272.
12. Warden SJ, Davis IS, Fredericson M. Management and prevention of bone stress injuries in long-distance runners. *J Orthop Sports Phys Ther*. 2014;44(1):749-765. doi: 10.2519/jospt.2014.5334. Epub 2014 Aug 7.
13. Fredericson M, Cookingham CL, Chaudhari AM, Dowdell BC, Oestreicher N, Sahrmann SA. Hip abductor weakness in distance runners with iliotibial band syndrome. *Clin J Sport Med*. 2000;10(3):169–175.
14. Niemuth PE, Johnson RJ, Myers MJ, Thieman TJ. Hip muscle weakness and overuse injuries in recreational runners. *Clin J Sports Med*. 2005;15:14-21.
15. Jonson SR, Gross MT. Intraexaminer reliability, interexaminer reliability, and mean values for nine lower extremity skeletal measures in healthy naval midshipman. *J Orthop Sports Phys Ther*. 1997;25(4):253-263.
16. Brady RJ, Dean JB, Skinner TM, Gross MT. Limb length inequality: clinical implications for assessment and intervention. *J Orthop Sports Phys Ther*. 2003;33(5):221-234.
17. Berryman-Reese N, Bandy WD. *Joint Range of Motion and Muscle Length Testing*, 2nd ed. Philadelphia, PA: Elsevier; 2010:324-327.
18. Barton CL, Bonanno D, Levinger P, Menz HB. Foot and ankle characteristics in patellofemoral pain syndrome: a case control and reliability study. *J Orthop Sports Phys Ther*. 2010;40(5):286-296. doi: 10.2519/jospt.2010.3227.
19. Davis DS, Quinn RO, Whiteman CT, Williams JD, Young CR. Concurrent validity of four clinical tests used to measure hamstring flexibility. *J Strength Cond Res*. 2008;22(2):583-588. doi: 10.1519/JSC.0b013e31816359f2.
20. Madeley LT, Munteanu SE, Bonanno DR. Endurance of the ankle joint plantar flexor muscles in athletes with medial tibial stress syndrome: a case-control study. *J Sci Med Sport*. 2007;10(6):356-362. Epub 2007 Mar 1.
21. Ireland ML, Willson JD, Ballantyne BT, Davis IM. Hip strength in females with

and without patellofemoral pain. *J Orthop Sports Phys Ther*. 2003;33(11):671–676.
22. Bolgla LA, Malone TR, Umberger BR, Uhl TL. Hip strength and hip and knee kinematics during stair descent in females with and without Patellofemoral pain syndrome. *J Orthop Sports Phys Ther*. 2008;38(1):12-18. doi: 10.2519/jospt.2008.2462. Epub 2007 Nov 21.
23. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometric*. 1977;33:159-174.
24. Rothstein JM. Measurement and Clinical Practice: The Theory and Application. In: Rothstein JM, ed. *Measurement in Physical Therapy*. New York, NY: Churchill Livingstone; 1985.
25. Haley SM, Osberg JS. Kappa coefficient calculation using multiple ratings per subject: a special communication. *Phys Ther*. 1989;69(11):970-974.
26. Boyd BS. Measurement properties of hand-held inclinometer during straight leg raise neurodynamic testing. *Physiotherapy*. 2012;98(2):174-179. doi: 10.1016/j.physio.2011.04.352. Epub 2011 Jun 8.
27. Simoneau GG, Hoenig KJ, Lepley JE, Papanek PE. Influence of hip position and gender on active hip internal and external rotation. *J Orthop Sports Phys Ther.* 1998;28(3):158-164.

Effectiveness of Thrust Manipulation of the Cervical Spine for Temporomandibular Disorder: A Systematic Literature Review

Philip Adelizzi, PT, DPT[1]
James Casler, PT, DPT[1]
Melissa DeFelice, PT, DPT[1]
Michael Drusedum, PT, DPT[1]
Timothy J. Bayruns, PT, DPT, OCS, CSCS[1]

[1]Thomas Jefferson University, Philadelphia, PA

ABSTRACT

Background and Purpose: Individuals with temporomandibular disorder commonly experience pain in and around the temporomandibular joint, decreased mouth opening, headaches, tinnitus, and dizziness. Common treatments for temporomandibular disorder include modalities, soft tissue mobilizations, mandibular mobilizations/manipulations, tongue controlled mouth opening exercises, alterations in diet and habits, and massage. Due to the biomechanical and physiological relationship between the temporomandibular joint and the cervical spine, it has been hypothesized that treatment for temporomandibular disorder could be directed to the cervical spine. Spinal manipulation, which has been validated in the literature as an acceptable form of treatment to decrease pain and improve function, could be aimed at the cervical spine to affect temporomandibular joint pain. The purpose of this systematic review of the literature is to determine the effectiveness of cervical manipulation on the treatment of symptoms related to temporomandibular disorder. **Methods:** The authors used Google Scholar, Cochrane, Scopus, PubMed, Ovid MEDLINE, and Cumulative Index of Nursing and Allied Health (CINAHL) when conducting a review of the research. Additional studies were added to the search from an outside source. Studies were eliminated by title, abstract, and review of complete text. The 6 remaining articles were read and graded using the PEDro scale. Inclusion criteria included the use of a cervical manipulation applied to the cervical spine to assess changes in symptoms in patients with TMD symptoms. **Results:** All 6 studies used cervical manipulation as a form of treatment. The studies that evaluated painfree active maximal mouth opening (PFAMMO) reported changes ranging from 1-15 mm with varied statistical significance. The studies that used the Visual Analog Scale (VAS) and/or pain scale reported a minimal change of 4.5 out of 10 indicating a significant reduction. With regard to the two randomized controlled trials that evaluated pain pressure threshold (PPT), changes ranged from 0.1 kg/cm^2-0.2 kg/cm^2. Two of the 6 studies supported the use of cervical spine manipulation as an effective treatment option for improving symptoms related to temporomandibular joint dysfunction. **Limitations:** Limited available research, low PEDro scores, weak study designs, variation in manipulation methods, small sample sizes, and the simultaneous use of other treatment interventions. **Conclusion:** High velocity low amplitude thrust manipulation applied to the cervical spine may be beneficial in achieving positive effects in patients with TMD symptoms. If a clinician is considering treating TMD only with cervical manipulation, further study to support its determined effects is needed.

Key Words: cervical manipulation, temporomandibular disorder, high velocity low amplitude

INTRODUCTION

The temporomandibular joint (TMJ), is used on a daily basis and is the most commonly used joint in the body.[1] Patients with temporomandibular disorders (TMD) will often experience headaches, tinnitus, pain, limited mouth opening, joint noises, ear aches, dizziness, and neck symptoms potentially originating from areas in close proximity to the TMJ or within the TMJ itself.[1] A national U.S. sample of 30,978 people found that 4.6% of the population reported having TMD-like symptoms.[2] Additionally, it has been shown that in patients who reported TMD-like symptoms, nearly 59% had comorbid pains with the strongest correlation being neck pain.[3]

The research literature has identified that the TMJ and cervical spine have a complex functional biomechanical relationship.[4,5] Altering position of the cervical spine (ie, forward head position) changes the natural alignment of cervical vertebrae as well as the positioning of the TMJ.[5,6] Temporomandibular disorder patients have been shown to be more likely to have postural abnormalities such as forward head position and decreased cervical lordosis.[6-8] Prolonged poor posture places undue stress on cervical vertebrae/disks, muscles, and neurovascular structures that may result in headaches, trigger points, and pain referral patterns.[6,9-11] It has been suggested that a proportionate relationship between TMJ dysfunction and neck pain exists, and that TMD symptoms are often misinterpreted and treated improperly.[12,13]

Common treatments for TMD symptoms have included modalities, soft tissue mobilizations, mandibular mobilizations and manipulations, tongue controlled mouth opening exercises, alterations in diet and habits, and massage with varied success.1 More recently, the literature has focused on intervention directed towards the cervical spine in hopes to affect TMD symptoms.[13-17] Patients with TMD seek treatment from a variety of practitioners, including dentists, physiatrists, physical therapists, and chiropractors.[14] Manipulations to the spine has been widely accepted as a treatment intervention for decreasing pain and improving function/mobility in multiple areas of the body.[18-23] This prior research warrants an investigation into using cervical manipulation as a means of treatment for TMD-related symptoms. The current literature is lacking in systematic reviews on the effectiveness of cervical manipulation for TMD. The purpose of this systematic review of the literature is to determine the effectiveness of cervical manipulation on the treatment of symptoms related to TMD.

METHODS

A search was conducted in July 2014 to locate literature to determine if manipulations applied to the cervical spine can be effective in the treatment of TMJ disorders. For this systematic review, a search was conducted using the following databases: Google Scholar, Cochrane, Scopus, PubMed, Ovid MEDLINE, and Cumulative Index of Nursing and Allied Health (CINAHL). The search terms used in this review of the literature included temporomandibular syn-

drome, temporomandibular joint, cervical spinal manipulation, cervical spine, TMJ, TMD, spinal manipulative therapy, and manipulation. Results were limited to English language only.

After deletion of duplicates, a total of 22 articles were exported into Refworks based on relevance to the topic after screening of the title. Studies were considered eligible for inclusion in this review if they included the use of a manipulation applied to the cervical spine to assess the effectiveness on the change in symptoms in those patients diagnosed with TMD. Studies were excluded from our review if they did not detail the use of manipulation applied to the cervical spine in patients with TMD symptoms. Studies were also excluded if treatment was performed to the TMJ joint instead of the cervical spine. Our definition of manipulation, for the purposes of this review, is a high velocity low amplitude thrust delivered to any cervical segment. Joint mobilizations were excluded if they were not high velocity, low amplitude thrusts. After reviewing the abstracts, 6 articles were excluded because they did not include the use of cervical manipulations. The remaining 16 articles were obtained in full text and reviewed by at least two members of the group. Of the 16 reviewed, one was excluded because it involved the use of cervical manipulations on asymptomatic patients, and 10 articles were excluded because the manual techniques used did not include cervical manipulations. The faculty research advisor provided us with 3 additional articles, which were excluded after reading the full text because they did not meet the inclusion criteria. One additional article was located for potential inclusion through review of the references section of the other reviewed articles. This left 6 articles remaining for inclusion in the review, which were read again in full text. A flowchart illustration is provided in Appendix 1. A summary of the remaining 6 articles can be found in Table 1.

After considering several research grading scales, the PEDro scale was selected because it is widely used and known as a valid measure of the methodological quality of clinical trials. It is also used to identify if trials are likely to be internally valid.[24] The PEDro scale was used to determine the quality and risk of bias for the studies selected. The PEDro scale is an 11-item scale that is used to rate the quality of RCTs. Each item contributes one point to the total possible score, 11 points.[24] Points were only awarded to our 6 remaining studies when a criterion was clearly reported. The 11 criteria are listed in Appendix 2. All members graded the selected articles and cross referenced the results to ensure agreement and conclude a final score. The faculty research advisor was informed of the grades and agreed with the group's scoring rationale. Several of the articles were not randomized clinical trials and thus received low scores on the PEDro scale due to lack of blinding procedures and the lack of control groups. However these articles were included in the review due to the limited amount of results found in the literature pertaining to the research topic.

RESULTS

Tables in Appendix 2 were created to compare results across all 6 studies. Article scores from the PEDRO scale ranged from zero to 8 out of 11 with a higher score correlating with higher levels of evidence. Two articles scored an 8,[26] one article scored a 2,[27] and 3 articles scored a zero.[28-30] Sample sizes range from 1 to 122.[25-30] Ages range from 20-47.[25-30] Two studies are randomized controlled trials,[25,26] 3 studies are case reports,[28-30] and one study is a prospective case series.[27] In regard to outcome measures, two studies used the visual analog scale (VAS),[27,30] 4 studies used painfree active maximal mouth opening (PFAMMO),[25-27,29] two studies used pressure pain threshold (PPT),[25,26] one study used a 0-10 pain scale,[29] and one study had no outcome measures.[28] All studies used cervical spine manipulation as a form of treatment. The authors of the review concluded, based on the results of all 6 studies, that cervical spine manipulation may be an effective treatment option for improving symptoms related to TMJ dysfunction.

Painfree Active Maximal Mouth Opening

Four studies used PFAMMO as an outcome measure to assess the effects of cervical spine manipulation.[25-27,29] Painfree active maximal mouth opening was measured in millimeters (mm) from the upper and lower central incisors. Normal PFAMMO range is considered to be between 40-50 mm for mouth opening and 8 mm for lateral excursion.[31] Two of the studies reported mean gains in maximal mouth opening ranging from 1.5 to 3.5 mm.[25,26] Two other studies reported the median gain in maximal mouth opening ranging from 1 to 15 mm.[27,29] The two randomized controlled trials reported significant findings with PFAMMO when comparing the control to treatment group.[25,26] The prospective case series and case study both showed improvements in PFAMMO but no statistical analyses were done.[27,29] A summary of the data collected can be found in Table 2.

Visual Analog Scale/0-10 Pain Scale

Two studies included the VAS as an outcome measure to quantify changes in TMJ pain before and after treatment.[27,30] One study used a 0-10 pain scale.[29] The VAS is measured in millimeters on a 100 mm scale. A higher rating signifies more intense pain reported by the subject. A higher rating on the 0-10 pain scale also signifies a more intense pain. The prospective case series reported a 45 mm median decrease in pain when compared to baseline.[27] Yulli[30] reported a baseline of 7 out of 10 on the VAS and a posttreatment VAS score of 0 out of 10. Houle[29] reported baseline TMJ pain rated 5/10 and 2/10 TMJ on the eighth visit. There were no reported pain measurements for this patient on subsequent visits. All of the studies reported improvements in pain for all subjects, but none of the studies reported any statistical analyses. A summary of the data collected can be found in Table 3.

Pain Pressure Threshold

Two studies used PPT as an outcome measure to determine the point when pressure on bones or muscles around the TMJ became painful. A higher PPT (kg/cm^2) means that the bone or muscle being tested can withstand higher amounts of pressure without being painful to the subject. Both randomized controlled trials demonstrated an increase in PPTs after treatment.[25,26] Mansilla et al[25] reported a mean PPT baseline of .8 kg/cm^2 over the sphenoid bone and a posttreatment mean PPT of .9 kg/cm^2. Oliveira et al[26] reported mean PPTs over the masseter and temporalis muscles. Mean baseline PPTs for both masseter and temporalis were 2.6 ± 0.7 kg/cm^2.[26] Mean posttreatment PPTs for both masseter and temporalis were 2.8 ± 0.7 kg/cm^2.[26] Both studies reported this data to be statistically significant.[25,26] A summary of the data collected can be found in Table 4.

DISCUSSION

The purpose of this systematic review is to investigate the effectiveness of cervical manipulations on the treatment of symptoms related to TMD. The results of the 6 included studies demonstrated that cervical spine manipulation is an effective treatment option for improving symptoms related to TMD. However several limitations can be cited and are listed in the following sections.

Table 1. Results from Included Studies

Author, Year	Study Design	Subjects, Gender	Age	Intervention	Chronicity of TMD	Outcome Measures	Conclusions	PEDro Score
Alcantara, 2002	Case Report	1; Female	41	Chiropractic approach of the Gonstead technique (high velocity, low amplitude trust) to reduce atlas subluxation	Not reported	None Reported	A HVLA trust to reduce atlas subluxation resulted in a reduction of TMJ symptoms and a decrease in headaches for a period of 9 months following treatment for the patient	0
DeVocht, 2003	Prospective Case Series	9; 7 females and 2 males	Median age of 27, range of 21 to 47 years	Use of the AAI while following the Activator Method, International protocol to the full spine and to the TMJ	Median of 8 years, ranging from 1 to 40 years	Visual Analog Scale (VAS) and Pain-Free Active Maximal Mouth Opening	TMD symptoms improved following treatment using the Activator Methods, International protocol for adjusting the TMJ	2
Houle, 2009	Case Study	1; Male	35	Chiropractic care include joint mobilizations of the TMJ, myofascial therapy, trigger point therapy, light spinal mobilizations of the upper cervical spine	Chronic – 8 years of constant pain	Visual Analog Scale (VAS) and Active Maximal Mouth Opening	After treatment aimed towards the TMJ and cervical spine, patient reported an absence of pain and muscle tenderness at the jaw and an increase in active mouth opening	0
Mansilla-Ferragut, 2009	Randomized Controlled Trial	37; Female	35, ± 8	Manipulative group: spinal manipulation directed at the AO joint. Control group: manual contact intervention	Symptoms present for at least 6 months	Pain-Free Active Maximal Mouth Opening and Pressure Pain Thresholds (PPTs)	Application of an AO joint manipulation results in an increase in active mouth opening and pressure pain thresholds	8
Oliveira-Campelo, 2010	Randomized Controlled Trial	122; 31 men and 91 women	20, ± 3	Manipulative group: AO joint trust Soft tissue group: inhibition technique over the suboccipital muscles Control group: No intervention	Not reported	Pain-Free Active Maximal Mouth Opening and Pressure Pain Thresholds (PPTs)	AO joint manipulation produces immediate increase in PPTs over latent TrPs in the masseter and temporalis muscles and increases minimum mouth opening	8
Yuill, 2009	Case Report	1; Male	31	Soft tissue therapy technique of ART, hyoid mobility treatment, TMJ mobilizations, and spinal manipulative therapy with rotary adjustment to C1-C2	Acute onset of symptoms	Visual Analog Scale (VAS)	The use of soft tissue therapy, hyoid mobility treatment, and spinal manipulative therapy was shown to decrease bilateral TMJ pain and bilateral temporal headaches	0

Abbreviations: AO, atlantooccipital joint; ART, active release technique; AAI, activator adjusting instrument II; HVLA, high velocity, low amplitude

Table 2. Synthesis of Results for Maximal Mouth Opening Data

Author and Year	Mean Pre-Tx MMO (Baseline)	Mean Post-Tx MMO	Mean Difference
Mansilla, 2008	35.4 mm (95% CI, 33.3-37.4)	38.8 mm (95% CI, 36.6-41.1)	3.5 mm (95% CI, 2.4-4.6)
Oliveira, 2010	46.4 mm + 6.8 (95% CI, 44.4, 48.4)	47.9 mm ± 6.8 (95% CI, 45.9, 49.9)	1.5 mm + 1.5 (95% CI, 1.0, 1.9)
Devocht, 2003	MEDIAN 38.0 mm	MEDIAN 44.5 mm	MEDIAN 9.0 mm
Houle, 2009	11 mm	12 mm	1.0 mm
Abbreviation: MMO, maximal mouth opening			

Table 3. Synthesis of Results for Visual Analog Scale and Pain Scale Data

Author and Year	Scale	Pre-Tx (Baseline)	Post-Tx	Difference
Devocht, 2003	VAS (reported in mm)	MEDIAN 65 mm (17-85)	MEDIAN 15 mm (1-53)	50 mm (16-32)
Yuill, 2009	VAS (reported 0/10)	7/10	0/10	7/10
Houle, 2009	Pain Scale (0/10)	5/10	8th visit 2/10, not measured in further tx sessions	3/10
Abbreviation: VAS, Visual Analog Scale				

Table 4. Synthesis of Results for Pain Pressure Threshold Data

Author and Year	Mean Pre-Tx PPT (Baseline)	Mean Post-Tx PPT	Mean Difference
Mansilla, 2008	Sphenoid Bone: 0.8 (95% CI, 0.6-0.9)	Sphenoid Bone: 0.9 (95% CI, 0.7-1.0)	Sphenoid Bone: 0.1 (95% CI, 0-0.2)
Oliveira, 2010	Masseter: 2.6 + 0.7 (95% CI, 2.4, 2.8) Temporalis: 2.6 + 0.7 (95% CI, 2.3, 2.8)	Masseter: 2.8 + 0.7 (95% CI, 2.6, 3.1) Temporalis: 2.8 + 0.7 (95% CI, 2.5, 3.1)	Masseter: 0.2 + 0.4 (95% CI, 0.1, 0.4) Temporalis: 0.2 + 0.3 (95% CI, 0.1, 0.4)
Abbreviation: PPT, pain pressure threshold			

Definition of Cervical Manipulation

All 6 of our studies examined the effects of cervical manipulations on the treatment of symptoms associated with TMD.[25-30] For the purposes of this literature review, we defined cervical manipulations as a high velocity, low amplitude thrust directed towards the cervical spine. We excluded articles discussing manipulations or mobilizations directed at the TMJ, unless they also included cervical manipulation as an additional intervention.[27,29,30] Mansilla-Ferragut et al[25] explains that manual treatment directed to the cervical segments of the spine has effects on decreasing sensitivity and pain over the muscles of mastication and over the TMJ. While we did define cervical manipulation to include high velocity, low amplitude thrust directed towards the cervical spine, we did not narrow the meaning of the manipulation to include only one specific technique. Furthermore, there was no standard technique for manipulation or standard protocol for frequency of treatment. In addition, patients in some studies received interventions besides cervical manipulation.[25-27,29,30] In one case study, the clinician provided full spine adjustment and manipulations directly to the TMJ with an instrument.[27] A case study by Houle and Descarrreaux[29] was chosen for inclusion, even though the authors described the intervention as "light spinal mobilizations," because the articles cited in reference to the intervention described manipulations, and we determined that there was a high likelihood that this was an issue in etymology, rather than technique, as the terms mobilization and manipulation are sometimes used interchangeably. These issues are further discussed in the limitations section below. Since there was not a standard manipulation or intervention protocol, it is more challenging to assert that cervical manipulations reduce symptoms of TMD. However, when reviewing the included articles, the general theme emerges that it appears likely that cervical manipulations have a positive effect on TMD symptoms. All 6 studies included in this review demonstrated improvements in symptoms in patients with TMD in some combination of outcome measures including PFAMMO,[25-27,29] PPT,[25,26] and a 0-10 pain scale.[29]

Main Findings/Strength of Evidence for Each Outcome

As previously mentioned, outcomes measures that were measured in the 6 articles we reviewed included PFAMMO,[25-27,29] PPT,[25,26] and a 0-10 pain scale.[29] In regards to PFAMMO, 4 studies used this as an outcome measure and all 4 demonstrated improvements, ranging from 1.0 mm mean difference to 9.0 mm median difference, supporting the theory that cervical manipulations may improve symptoms of TMD.[25-27,29] In terms of changes in pain scale, in one study the patient reported a decrease in pain from 5/10 at evaluation to 2/10 during the 8th visit.[29] Significant improvements in TMD symptoms were also reported in the VAS in two other studies.[27,30] Finally, in regards to PPT data, two studies reported small improvements in reported PPT after interventions.[25,26]

One may argue that some of the differences in outcome measures, such as changes in PPT may be statistically significant but not clinically relevant. For example, the RCT by Mansilla-Ferragut et al[25] found a mean difference of .1kg/cm^2 in PPT after intervention, which was determined to be statistically significant but has little clinical relevance to a practitioner. On the other hand, one may also argue that some of the increases in PFAMMO after intervention are not statistically significant. When looking at Table 2, the

average baseline measurement in both of the RCTs[25,26] and one case study by Houle and Cescarreaux[29] all met normal range of motion values, therefore, finding large differences in PFAMMO would be infeasible and needs to be considered when evaluating the results. However, small increases in PFAMMO may be clinically significant for patients as it may allow them to resume normal activities that they may otherwise have been unable to do. For example, in the case study by Houle and Descarreaux,[29] the subject experienced an increase in PFAMMO of only 1 mm from pre- to posttreatment, but subjectively reported that he could insert a tobacco pipe between his teeth, a task which he had been unable to do for years, thereby improving his perceived quality of life (QOL).[29] It should be noted that in this case study, the participant also received other interventions besides cervical manipulation.[29]

The quantitative improvements in symptoms in patients with TMD previously discussed, in addition to other reported subjective improvements in symptoms in some studies, support the use of cervical manipulation, in coordination with other interventions, which leads to positive effects and improvements in TMD care.

Risks of Cervical Manipulation

One possible reason for the limited quantity of studies on the topic of cervical manipulation is that there is some controversy as to whether possible risks associated with the technique are too great. Some hypothesized adverse effects include ischemic stroke and carotid artery dissection.[32,33] However, a recent literature review by Chung et al[33] did not identify valid evidence that can be used to support or refute the presence of an association between cervical spine manipulation and internal carotid artery dissection. Nevertheless, many physical therapists may be hesitant to use cervical manipulations, thus highlighting the need for additional, high quality research on the topic to provide context to the issue.

Funding Bias

None of the 6 articles reviewed identified any outside source of compensation or funding.[25-30] One study used an instrument, the Activator Adjusting Instrument II (AAI) designed by Activator Methods International of Phoenix, AZ, to deliver manipulations and mobilizations but did not report receiving any funding from the maker of the instrument.[27]

Limitations and Recommendations for Future Research

The literature is limited regarding the effectiveness of cervical manipulations towards the treatment of TMD, therefore, only 6 articles met the inclusion criteria for this review. Two of the articles (Mansilla-Ferragut, 2009[25] and Oliveira-Campelo, 2010[26]) supported the effectiveness of this intervention. This current review has several limitations that must be addressed in order to make recommendations for clinical use. First, it must be recognized that the lower quality study designs of the reviewed articles were a limiting factor. Only two articles[25,26] were randomized clinical trials, while the remaining 4 articles were case series studies. The two RCT articles were the highest rated articles and both received a score of 8 out of 11 on the PEDro scale.[25,26] The case series studies were included in this review and were weak in study design due to the lack of control groups to compare the effects of a manual treatment directed at the cervical spine, the lack of blinding of the therapists and subjects, and the lack of between group statistical comparisons for the outcome measures. These articles were not excluded due to limited research in this area of topic and the value of the results. The overall trend of all of the remaining articles supported cervical manipulation for treatment of TMJ disorders.

Secondly, 3 of the 6 articles were single case studies and had small sample sizes.[28-30] In addition, one article only used female subjects.[25] Therefore, we do not know if the effects of this manual treatment can be generalized to the male population of similar age. Also, some studies lacked a long-term follow-up appointment to examine the effects of cervical manipulation on outcome measures such as maximal mouth opening and the VAS. Future research should include a long-term follow-up and a greater sample size including both male and female subjects. Results were limited to English only, however, one potentially relevant study was found in another language but was not included in this due to the unavailability in English. In addition, unpublished articles were located but were not included in this review because of lack of availability. Therefore, the research presented in this review of the literature may not be representative of all the existing body of evidence on this topic.

The use of other treatment interventions in these 6 studies is another limitation within this review of the literature. In a case series report by Yuill et al,[30] the subject received active release soft tissue therapy, hyoid mobility treatment, and spinal manipulative therapy with rotary adjustment to C1-2. In addition, the case series by Houle and Descarreaux[29] completed chiropractic care of myofascial therapy, trigger point therapy, and spinal mobilizations of the upper cervical spine. The randomized controlled trial by Oliveira-Campelo et al,[26] randomly assigned subjects to 3 groups—a manipulative group, a soft tissue group, and a control group—who received no intervention. Consequently, it is difficult to establish conclusions about the effectiveness of cervical manipulations due to multiple interventions performed on the patients, in addition to cervical spine manipulations. Within our final 6 articles, 5 had a common variable of using either using the VAS, PFAMMO, and PPT as the outcome measure. However, one article by Alcantara et al[28] reported no outcome measures, beyond the patient's subjective report of improvement in symptoms, to examine the efficiency of the manual treatment. Further studies should consider an appropriate set of outcomes measures to help clinicians determine the value of their plan of care.

The variability between the studies regarding cervical manipulation is another limitation. There is not a standard technique of cervical manipulation directed towards the cervical spine for the treatment of TMD. The protocol varied between studies, which makes it difficult to determine conclusions and make clinical recommendations for further research and clinical practice. The DeVocht et al[27] prospective case series used full spinal manipulation, including cervical manipulation, but did not specify the exact technique, frequency, or location of manipulation. Recommendations for future research should focus on incorporating stronger research designs to determine if cervical manipulations can make an impact on TMD symptoms.

Another possible limitation involves variability in the onset and duration of symptoms among the sample patient populations in the reviewed articles. In some studies, the onset of TMD symptoms were acute,[30] while in other cases the duration of symptoms was much longer, with onset of symptoms occurring years in the past.[27,29,30] In one instance, the subject of the case report by Houle and Descarreaaux[29] reported experiencing pain of insidious onset and of a constant nature for the last 8 years. In the randomized controlled trial by Mansilla-Ferragut and colleagues,[25] inclusion criteria were that TMD symptoms were present for a minimum of 6 months.[25] This raises the question as to whether cervical manipulation may have varying levels of effec-

tiveness on TMD symptoms depending on whether the symptoms are acute or chronic. A 2010 Cochrane review by Gross et al[34] found that the use of cervical manipulations on the relief of subacute/chronic neck pain, revealed "moderate quality of evidence suggesting manipulation and mobilization produced similar effects on pain, function and patient satisfaction. There is low quality evidence showing manipulation alone versus a control may provide intermediate and short-term relief following 1 to 4 sessions."[34] Gross et al[34] also found that "optimal technique and dose need to be determined."[34] Further research on the effectiveness of cervical manipulations on TMD symptoms should address the issue of symptom variation in terms of being of an acute versus chronic nature in order to provide guidance for patient plan of care and treatment. Another factor that needs to be considered when determining treatment is the origin of TMD symptoms. A recent article by Harrison et al[35] detailed the different disorders of TMD symptoms, potential patient presentation, and appropriate means of intervention for each disorder.[35] Cervical manipulation may or may not be an appropriate intervention for all of the different TMDs and is another factor that needs to be considered when deciding treatment interventions.

CONCLUSION

The literature in this review demonstrates that cervical manipulations are effective in improving symptoms in patients with TMD symptoms. While the literature reviewed was somewhat limited in quantity and quality, two articles exhibited strong data to support the use of manipulations. The overall theme that emerged was that patients in all studies appeared to have decreased symptoms related to TMD as a result of interventions including, but not limited to, cervical spinal manipulation. This being the case, the authors of this review believe that cervical manipulation along with conventional treatment appears to be beneficial in treating TMD. However if a clinician is considering treating TMD solely with manipulation, then further study is needed to lend support to this treatment alone.

Clinical Recommendation

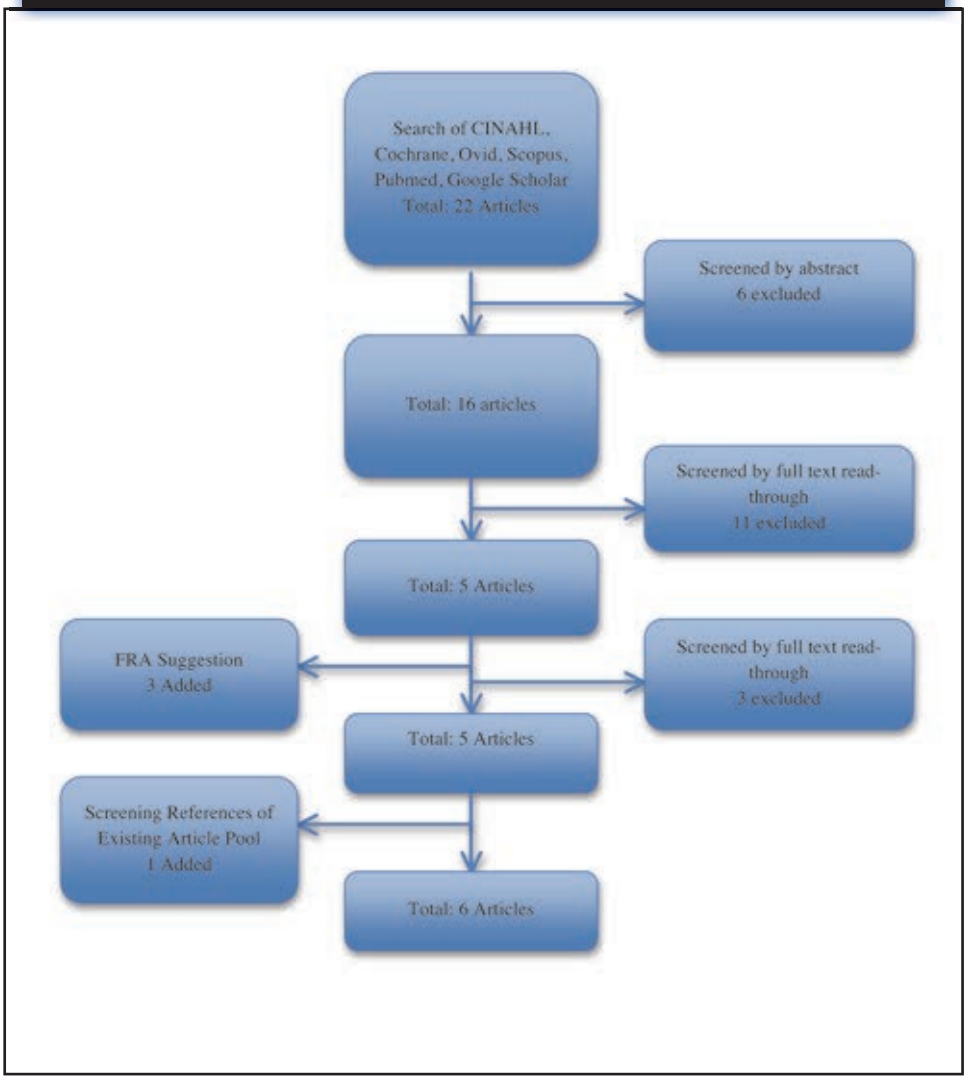
The articles and data reviewed in this paper demonstrate that, in combination with other treatment interventions, cervical manipulation is useful in the treatment of TMD. The use of cervical manipulation alone for treatment of TMD requires further research.

REFERENCES

1. Ho S. T*he Temporomandibular Joint: Physical Therapy Patient Management Utilizing Current Evidence*. La Crosse, WI: APTA, Inc.; 2011.
2. Plesh O, Adams SH, Gansky SA. Temporomandibular joint and muscle disorder-type pain and comorbid pains in a national US sample. *J Orofac Pain.* 2011;25(3):190-198.
3. Isong U, Gansky SA, Plesh O. Temporomandibular joint and muscle disorder-type pain in U.S. adults: the National Health Interview Survey. J *Orofac Pain*. 2008;22:317-322.
4. Eriksson PO, Zafar H, Nordh E. Concomitant mandibular and head-neck movements during jaw opening-closing in man. *J Oral Rehabil*. 1998;25(11):859-870.
5. La Touche R, Paris-Alemany A, von Piekartz H, Mannheimer JS, Fernandez-Carnero J, Rocabado M. The influence of cranio-cervical posture on maximal mouth opening and pressure pain threshold in patients with myofascial temporomandibular pain disorders. *Clin J Pain*. 2011;27(1):48-55. doi: 10.1097/AJP.0b013e3181edc157.
6. Olivo SA, Magee DJ, Parfitt M, Major P, Thie NM. The association between the cervical spine, the stomatognathic system, and craniofacial pain: A critical review. *J Orofac Pain*. 2006;20(4):271-287.
7. Braun BL. Postural differences between asymptomatic men and women and craniofacial pain patients. *Arch Phys Med Rehabil*. 1991;72(9):653-656. doi: 0003-9993(91)90208-Z.
8. Lee WY, Okeson JP, Lindroth J. The relationship between forward head posture and temporomandibular disorders. *J Orofac Pain*. 1995;9(2):161-167.
9. Fukui S, Ohesto K, Shiotani M, et al. Cervical zygapophyseal joint pain patterns—Pain distribution determined by electrical stimulation of the cervical dorsal rami. *Pain Clinic*. 1996;9: 285-293.
10. Wright EF. Referred craniofacial pain patterns in patients with temporomandibular disorder. *J AM Dent Assoc*. 2000;131:1307-1315.
11. Carlson CR, Okeson JP, Falace DA, Nitz AJ, Lindroth JE. Reduction of pain and EMG activity in the masseter region by trapezius trigger point injection. *Pain*. 1993;55(3):397-400.
12. Ciancaglini R, Testa M, Radaelli G. Association of neck pain with symptoms of temporomandibular dysfunction in the general adult population. *Scand J Rehabil Med.* 1999;31(1):17-22.
13. von Piekartz H, Hall T. Orofacial manual therapy improves cervical movement impairment associated with headache and features of temporomandibular dysfunction: A randomized controlled trial. *Man Ther.* 2013;18(4):345-350.
14. Brantingham JW, Cassa TK, Bonnefin D, et al. Manipulative and multimodal therapy for upper extremity and temporomandibular disorders: A systematic review. *J Manipulative Physiol Ther*. 2013;36(3):143-201.
15. Kraus S. Temporomandibular disorders, head and orofacial pain: Cervical spine considerations. *Dent Clin North Am*. 2007;51(1):161-193.
16. La Touche R, Fernandez-de-las-Penas C, Fernandez-Carnero J, et al. The effects of manual therapy and exercise directed at the cervical spine on pain and pressure pain sensitivity in patients with myofascial temporomandibular disorders. *J Oral Rehabil*. 2009;36(9):644-652. doi: 10.1111/j.1365-2842.2009.01980.x.
17. Tuncer AB, Ergun N, Tuncer AH, Karahan S. Effectiveness of manual therapy and home physical therapy in patients with temporomandibular disorders: A randomized controlled trial. *J Bodywork Movement Ther*. 2013;17(3):302-308.
18. Fernandez-Carnero J, Fernandez-de-las-Penas C, Cleland JA. Immediate hypoalgesic and motor effects after a single cervical spine manipulation in subjects with lateral epicondylalgia. *J Manipulative Physiol Ther*. 2008;31(9):675-681. doi: 10.1016/j.jmpt.2008.10.005.
19. Fernandez-de-Las-Penas C, Alonso-Blanco C, Cleland JA, Rodriguez-Blanco C, Alburquerque-Sendin F. Changes in pressure pain thresholds over C5-C6 zygapophyseal joint after a cervicothoracic junction manipulation in healthy subjects. *J Manipulative Physiol Ther.* 2008;31(5):332-337. doi: 10.1016/j.jmpt.2008.04.006.
20. Fernandez-de-las-Penas C, Perez-de-Heredia M, Brea-Rivero M, Miangolarra-Page JC. Immediate effects on pressure pain threshold following a single cervical spine manipulation in healthy subjects. *J Orthop Sports Phys Ther*. 2007;37(6):325-329. doi: 10.2519/jospt.2007.2542.
21. Martinez-Segura R, Fernandez-de-las-Penas C, Ruiz-Saez M, Lopez-Jimenez

C, Rodriguez-Blanco C. Immediate effects on neck pain and active range of motion after a single cervical high-velocity low-amplitude manipulation in subjects presenting with mechanical neck pain: A randomized controlled trial. *J Manipulative Physiol Ther*. 2006;29(7):511-517. doi: S0161-4754(06)00175-8.
22. Ruiz-Saez M, Fernandez-de-las-Penas C, Blanco CR, Martinez-Segura R, Garcia-Leon R. Changes in pressure pain sensitivity in latent myofascial trigger points in the upper trapezius muscle after a cervical spine manipulation in pain-free subjects. *J Manipulative Physiol Ther*. 2007;30(8):578-583. doi: S0161-4754(07)00246-1.
23. Bronfort G, Haas M, Evans RL, Bouter LM. Efficacy of spinal manipulation and mobilization for low back pain and neck pain: A systematic review and best evidence synthesis. *Spine J*. 2004;4(3):335-356. doi: 10.1016/j.spinee.2003.06.002.
24. Maher CG., Sherrington C, Herbert RD, Moseley AM, Elkins M. (2003). Reliability of the PEDro scale for rating quality of randomized controlled trials. *Phys Ther.* 2003;83(8):713-721.
25. Mansilla-Ferragut P, Fernandez-de-Las Penas C, Alburquerque-Sendin F, Cleland JA, Bosca-Gandia JJ. Immediate effects of atlanto-occipital joint manipulation on active mouth opening and pressure pain sensitivity in women with mechanical neck pain. *J Manipulative Physiol Ther.* 2009;32(2):101-106. doi: 10.1016/j.jmpt.2008.12.003.
26. Oliveira-Campelo NM, Rubens-Rebelatto J, Marti N-Vallejo FJ, Alburquerque-Sendi NF, Fernandez-de-Las-Penas C. The immediate effects of atlanto-occipital joint manipulation and suboccipital muscle inhibition technique on active mouth opening and pressure pain sensitivity over latent myofascial trigger points in the masticatory muscles. *J Orthop Sports Phys Ther*. 2010;40(5):310-317. doi: 10.2519/jospt.2010.3257.
27. DeVocht JW, Long CR, Zeitler DL, Schaeffer W. Chiropractic treatment of temporomandibular disorders using the activator adjusting instrument: A prospective case series. *J Manipulative Physiol Ther*. 2003;26(7):421-425.
28. Alcantara J, Plaugher G, Klemp DD, Salem C. Chiropractic care of a patient with temporomandibular disorder and atlas subluxation. *J Manipulative Physiol Ther*. 2002;25(1):63-70. doi: a0250063.
29. Houle S, Descarreaux M. Conservative care of temporomandibular joint disorder in a 35-year-old patient with spinal muscular atrophy type III: A case study. *Journal of Chiropractic Medicine*. 2009;8(4):187-192. http://dx.doi.org.proxy1.lib.tju.edu/10.1016/j.jcm.2009.07.005.
30. Yuill E, Howitt SD. Temporomandibular joint: Conservative care of TMJ dysfunction in a competitive swimmer. *J Can Chiropr Assoc*. 2009;53(3):165-172.
31. Levangie PK, Norkin CC. *Joint Structure & Function: A Comprehensive Analysis*. 4th ed. Independent Publishers. F.A. Davis; 2005.
32. Haneline MT, Croft AC, Frishberg BM. Association of internal carotid artery dissection and chiropractic manipulation. *Neurologist*. 2003;9:35-44.
33. Chung CL, Côté P, Stern P, L'espérance G. The association between cervical spine manipulation and carotid artery dissection: a systematic review of the literature. *J Manipulative Physiol Ther.* 2014;
34. Gross A, Miller J, D'Sylva J, et al. Manipulation or mobilisation for neck pain. *Cochrane Database Syst Rev*. 2010 Jan 20;(1):CD004249.. doi:10.1002/14651858.CD004249.pub3.
35. Harrison AL, Thorp JN, Ritzline PD. A proposed diagnostic classification of patients with temporomandibular disorders: implications for physical therapists. *J Orthop Sports Phys Ther*. 2014;44(3):182-197. doi: 10.2519/jospt.2014.4847.

Appendix 1. Literature Selection Process



Appendix 2. PEDro Grading Scale

1. Eligibility criteria were specified.
2. Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received.
3. Allocation was concealed.
4. The groups were similar at baseline regarding the most important prognostic indicators.
5. There was blinding of all subjects.
6. There was blinding of all therapists who administered the therapy.
7. There was blinding of all assessors who measured at least one key outcome.
8. Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups.
9. All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat."
10. The results of between-group statistical comparisons are reported for at least one key outcome.
11. The study provides both point measures and measures of variability for at least one key outcome.

Use of Taping for Support Following Clavicular Fracture

Colleen N. Gulick, MS, BS (BioE), EIT (MechE), CSCS[1]
Dawn T. Gulick, PhD, PT, ATC, CSCS[2]

[1]Graduate Student Clinical Exercise Physiology, California State University–Fullerton, Fullerton, CA
[2]Professor of Physical Therapy, Widener University, Chester, PA

ABSTRACT

Numerous shoulder injuries require the use of a sling for support and protection. However, prolonged immobilization can result in joint and soft tissue limitations that can negatively influence mobility. The use of a clinical taping technique may have benefit in providing support to the upper extremity and facilitating early mobilization.

Key Words: athletic taping, shoulder support, shoulder mobility

CLINICAL PROBLEM

Clavicular fractures, acromioclavicular separations, shoulder subluxations, rotator cuff, and labral injuries/repairs are just a few of the conditions for which a shoulder sling is recommended.[1,2] The purpose of a sling is to facilitate healing by unweighting the injured structures.[2] Yet a sling use does not always put the upper extremity in an optimal position. Shoulder adduction with internal rotation has been reported to increase soft tissue tension on several structures of the shoulder.[3-5] Studies have suggested that the positioning of traditional slings may inhibit healing.[3-5] In addition, prolonged immobilization can result in the formation of adhesions and muscle shortening, causing restriction of both arthrokinematic and osteokinematic movements.[6-11]

The application of various taping techniques can be used to support a joint or structure while it is in the process of healing. Theoretically, tape can serve as an elastic lever to absorb load,[12] improve the length-tension relationship of a muscle,[13] and provide postural correction. Although the technique described here applies to a clavicular fracture, the principles may be applied to other shoulder conditions that could benefit from dynamic assistance. Dynamic Tape (PosturePals Pty Ltd, Port Vila, Vanuatu, South Pacific) is an elastic tape that was specifically selected for this technique due to its strong recoil properties. The highly elastic, laminated construction stretches in all directions. Thus, when placed in a stretched form along the line of pull of a specific muscle, the recoil of the tape provides mechanical assistance to decrease the tension/load on the injured tissue.[14,15] The tape is reported to store energy as elastic potential energy roughly equal to the amount of energy that was used to stretch it.[15] The stored, elastic potential energy is then converted to kinetic energy as muscle shortening occurs.[15]

The case presented is a mid-clavicular fracture in a 24-year-old elite, female cyclist involved in a velodrome crash while racing (Figure 1). The athlete's clavicle was repaired with an open reduction internal fixation procedure within 24 hours of injury (Figure 2). Following surgery, the athlete's affected upper extremity was placed in a traditional sling. Though early mobilization and facilitation of local muscular activity are critical for a prompt return to sport,[7] soft tissue stresses in the acute phase of healing can produce pain and prohibit early gains in motion and strength. Although typical sling use for a clavicular fracture is 1 to 3 weeks,[16] through the application of Dynamic Tape, this athlete was able to increase her painfree shoulder range of motion and eliminate the use of the sling by postoperative day 6. With the application of the tape, the athlete was able to position her hands on the handlebars of a stationary bike to resume training. This task could not be safely performed with the sling. The technique used on this athlete was based on principles of kinesiology. The choice to tape the supraspinatus was based on the desire to maintain glenohumeral approximation, ie, superior pull on the humerus. The decision to tape the scapula was to optimize the position and enhance the length-tension relationship associated with normal scapulohumeral rhythm. To date, this taping technique has not been reported in the literature. See Figure 3 for the technique used.

INTERVENTION

Strip #1

Position: sitting with arm is 90° of scaption. This position was selected to place the supraspinatus in a shortened position.

Measurement: a measurement from the supraspinatus muscle proximal attachment (most medial portion of the suprascapular fossa) to the distal attachment (greater tubercle of the humerus) was taken and measured 24 cm. A piece of Dynamic Tape was cut to this length.

Tape application: the tape was secured approximately 2 cm distal to the greater tubercle and stretched along the path of the supraspinatus to approximately 2 cm medial to the suprascapular fossa (Figure 4).[17] Total distance covered by the tape was 26.5 cm; this represented an estimated 10% stretch of the tape.

Strip #2

Position: sitting with bilateral scapular adduction and retraction. This position was selected to place the rhomboids and scapular stabilizers in a shortened position.

Measurement: a measurement from the axillary border of the right scapula to the axillary border of the left scapula at the T4-5

Figure 1. Radiograph of a fractured clavicle.

Figure 2. Radiograph of open reduction internal fixation of a clavicle fracture.

Figure 3. Dynamic taping technique for shoulder support.

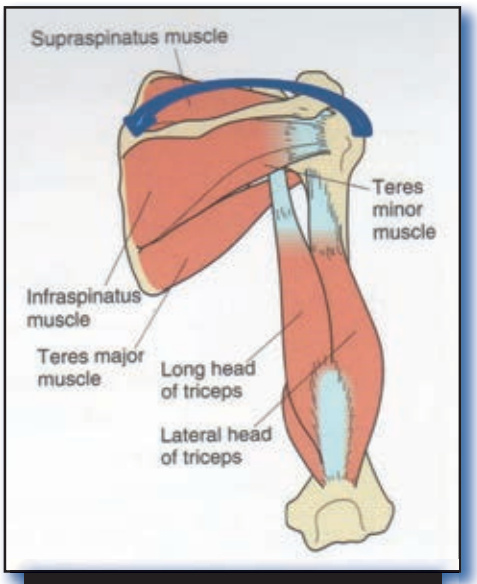


Figure 4. Direction of supraspinatus support. Reprinted with permission from F.A. Davis.[17] Copyright 2013, F.A. Davis.

Figure 5. Direction of scapular support. Reprinted with permission from Therapeutic Articulations.[18] Copyright 2016, Therapeutic Articulations.

level was taken and measured 26 cm. A piece of Dynamic Tape was cut to this length.

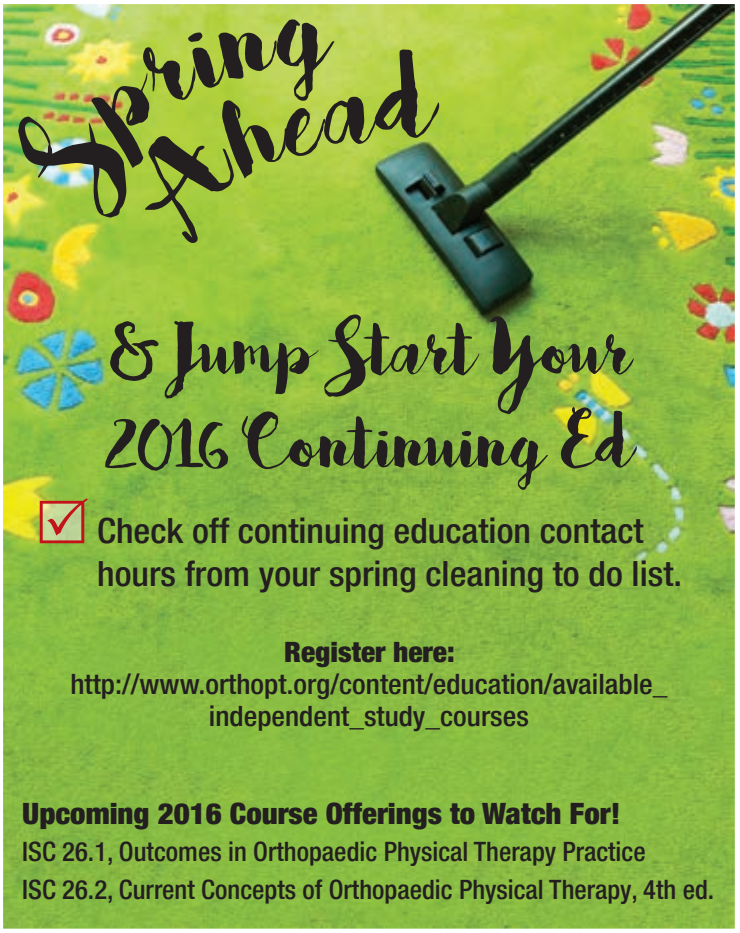
Tape application: the middle of the tape was secured at the T4-5 level of the spine. While holding the tape with the left hand, the tape was stretched laterally with the right hand to a position approximately 2 cm lateral to the axillary border of the right scapula. Then the right hand was used to secure the tape at midline while the left hand was used to stretch the tape approximately 2 cm lateral to the axillary border of the left scapula (Figure 5).[18] Total distance covered by the tape was 30 cm, this represented an estimated 15% stretch of the tape. This is consistent with the 5% to 30% range recommended by other taping techniques.[14,15]

CLINICAL APPLICATION

In summary, Dynamic Tape may be a valuable resource to facilitate early mobilization after a fracture and/or soft tissue injury. The components of this nylon and Lycra blended tape can be applied to soft tissue using the principles of position, leverage, and force vectors to support a limb, unload a tissue, and assist with postural correction.[14,15] However, tape is not meant to replace rigid or absolute immobilization in cases where soft tissue needs to be completely rested. This technique is not intended for acute soft tissue injuries or fractures that are unstable. Yet, postural dysfunctions, surgically fixated fractures, and perhaps even hypotonic shoulders after a stroke, may lend themselves to this technique. At this time, research on Dynamic Tape for the upper extremity is limited but could have great potential.

REFERENCES

1. Toogood P, Horst P, Samagh S, Feeley BT. Clavicle fractures: a review of the literature & update on treatment. *Phys Sportsmed*. 2011;39(3):142-150. doi: 10.3810/psm.2011.09.1930.
2. Sears B. How to properly wear a sling on your shoulder. May 3, 2015. Available at: http://physicaltherapy.about.com/od/devicesandorthotics/qt/Properly-Wear-A-Sling.htm. Accessed July 15, 2015.
3. Hoppes CW. Immobilization in neutral rotation for a glenohumeral dislocation using a sling and splint. *N Am J Sports Phys Ther*. 2008;3(1):22-24.
4. Limpisvasti O, Yang BY, Hosseinzadeh P, Leba TB, Tibone JE, Lee TQ. The effect of glenohumeral position on the shoulder after traumatic anterior dislocation. *Am J Sports Med*. 2008;36(4):775-780. doi: 10.1177/0363546507312163. Epub 2008 Jan 22.
5. Liavaag S, Stiris MG, Lindland ES, Enger M, Svenningsen S, Brox JI. Do Bankart lesions heal better in shoulders immobilized in external rotation? *Acta Orthopaedica*. 2009;80(5):579-584. doi: 10.3109/17453670903278266.
6. Akeson WH, Amiel D, Abel MF, Garfin SR, Woo SL. Effects of immobilization on joints. *Clin Orthop Relat Res*. 1987;219:28-37.
7. Kannus P. Immobilization or early mobilization after acute soft tissue injury? *Phys Sports Med*. 2000;28(3):55-63.
8. Schollmeier G, Uhthoff HK, Sarkar K, Fukuhara K. Effects of immobilization on the capsule of the canine glenohumeral joint: A structural functional study. *Clin Orthop Relat Res*. 1994;304:37-42.
9. Lui YL, Ao YF, Cui GQ, Zhu JX. Changes of histology and capsular collagen in a rat shoulder immobilization model. *Chin Med J (Engl)*. 2011;124(23):3939-3944.
10. Bolzoni F, Bruttini C, Esposti R, Cavallari P. Hand immobilization affects arm and shoulder postural control. *Exp Brain Res*. 2012;220(1):63-70. doi: 10.1007/s00221-012-3115-7. Epub 2012 May 23.
11. McDonough AL. Effects of immobilization and exercise on articular cartilage-a review of literature. *J Orthop Sports Phys Ther*. 1981;3(1):2-5.
12. Soslowsky LJ, Thomopoulos S, Esmail A, et al. Rotator cuff tendinosis in an animal model: role of extrinsic and overuse factors. *Ann Biomed Eng*. 2002;30(8):1057-1063.
13. Lacourpaille L, Hug F, Nordez A. Passive muscle tension on electromechanical delay in humans. January 4, 2013. Available at: http://www.researchgate.net/publication/234106177_Influence_of_Passive_Muscle_Tension_on_Electromechanical_Delay_in_Humans. Accessed July 15, 2015.
14. DYNAMicTapE.com. Comparison Chart Explanatory. Available at: http://www.mspopleidingen.nl/userfiles/files/Comparison%20Chart%20Explanatory%20Notes.pdf. Accessed November 12, 2015.
15. DYNAMicTapE.com Advanced Dynamic Taping Guide for Professionals. Available at: http://www.dynamictape.com/sites/default/files/Advguide0313_withbleed.pdf. Accessed November 12, 2015.
16. Toogood P, Horst P, Samagh S, Feeley BT. Clavicle fractures: a review of the literature & update on treatment. *Phys Sportsmed*. 2011;39(3):142-150. doi: 10.3810/psm.2011.09.1930.
17. Gulick DT. *OrthoNotes*. 3rd ed. Philadelphia, PA: F.A. Davis; 2013:39.
18. Gulick DT. iOrtho + Mobile App. www.app.iortho.xyz/2016. Accessed November 12, 2015.


Spring Ahead
& Jump Start Your 2016 Continuing Ed
Check off continuing education contact hours from your spring cleaning to do list.
Register here:
http://www.orthopt.org/content/education/available_independent_study_courses
Upcoming 2016 Course Offerings to Watch For!
ISC 26.1, Outcomes in Orthopaedic Physical Therapy Practice
ISC 26.2, Current Concepts of Orthopaedic Physical Therapy, 4th ed.


THE RIGHT TOOLS WITH THE RIGHT RESISTANCE EVERY TIME
Bounce Back with Resistance
MEDICORDZ
Gear to reduce pain, rehab injuries.
MADE IN THE USA
NZCordz.com | 800.886.6621


2017 Annual Orthopaedic Section Meeting
Plan to Attend
Hyatt Regency Mission Bay Spa & Marina | San Diego, CA
April 20–22, 2017

2016 CSM Award Winners

February 19, 2016
Anaheim, California

PARIS DISTINGUISHED SERVICE AWARD

The Paris Distinguished Service Award is the highest honor awarded by the Orthopaedic Section and is given to acknowledge and honor an Orthopaedic Section member whose contributions to the Section are of exceptional and enduring value. The recipient of this award is provided an opportunity to share his or her achievements and ideas with the membership through a lecture presented at APTA Combined Sections Meeting.

Guy G. Simoneau, PT, PhD, is currently Professor, Department of Physical Therapy, Marquette University Editor of special issues *Journal of Orthopaedic & Sports Physical Therapy*.

Dr. Simoneau received his B.S. in physical therapy from the University of Montreal (1982), his M.S. in physical education/sports medicine from the University of Illinois at Urbana-Champaign (1984), and his PhD in exercise and sport science/locomotion studies from the Pennsylvania State University (1992). He has been a faculty member in the Department of Physical Therapy at Marquette University since 1992. His primary area of teaching is orthopaedic and sports physical therapy. He has published several research articles and book chapters on topics related to orthopaedic/sports physical therapy and biomechanics. Dr. Simoneau has previously received research funding from the National Institutes of Health (NIH), the National Institute of Occupational Safety and Health (NIOSH), the Arthritis Foundation, and the Foundation for Physical Therapy, among others. His teaching, service, and research efforts have been recognized through several national awards from the American Physical Therapy Association. These include the 2010 Lucy Blair Service Award, the 2004 Chattanooga Research Award, the 2003 Baethke/Carlin Teaching Award, the 2000 Award for Excellence in Teaching of Orthopaedic Physical Therapy from the Orthopaedic Section, and the 1997 Education Award from the Sports Section. In addition, Dr. Simoneau received the Teacher of the Year Award at Marquette University in 2001. Dr. Simoneau has lectured extensively around the world on orthopaedic/sports physical therapy practice and various aspects of the research/publication process. Most recently, he completed a 5-month Fulbright experience at the Kathmandu University School of Medical Sciences in Dhulikhel, Nepal. Dr. Simoneau was the Editor-in-Chief of the *Journal of Orthopaedic & Sports Physical Therapy* from 2002 to 2015, and since January 2016 continues to serve the *Journal* in the capacity of Editor of special issues.

ROSE EXCELLENCE IN RESEARCH AWARD

The purpose of this award is to recognize and reward a physical therapist who has made a significant contribution to the literature dealing with the science, theory, or practice of orthopaedic physical therapy. The submitted article must be a report of research but may deal with basic science, applied science, or clinical research.

Anthony Delitto, PhD, PT, FAPTA, is currently Professor and Dean, School of Health and Rehabilitation Sciences (SHRS) and Professor, Department of Physical Therapy, SHRS, and Vice President for Education and Research, UPMC Centers for Rehab Services. Tony has authored or co-authored over 100 peer-reviewed research papers. Dr. Delitto actively treats people with painful musculoskeletal disorders and his current research is focused on implementing classification and treatment effectiveness studies into quality improvement initiatives. He is also conducting trials in exercise interventions for people with Parkinson's disease. He was recently awarded one of the first large pragmatic trials from the Patient-Centered Outcomes Research Institute (PCORI), a multi-site, $13 million grant (the TARGET study) to investigate innovative ways to reduce the transition of acute low back pain by having physical therapists partner with primary care and deliver psychologically informed physical therapy to patients with acute low back pain who are at risk for persistent pain.

JAMES A GOULD EXCELLENCE IN TEACHING ORTHOPAEDIC PHYSICAL THERAPY AWARD

This award is given to recognize and support excellence in instructing orthopaedic physical therapy principles and techniques through the acknowledgement of an individual with exemplary teaching skills. The instructor nominated for this award must devote the majority of his or her professional career to student education, serving as a mentor and role model with evidence of strong student rapport. The instructor's techniques must be intellectually challenging and promote necessary knowledge and skills.

George J. Davies, DPT, MED, PT, SCS, ATC, LAT, CSCS, PES, FAPTA, currently holds the following positions: Professor, Armstrong State University; Professor Emeritus, UW-LaCrosse; Sports Physical Therapist Coastal Therapy, Savannah, GA, and Gundersen Lutheran Sports Medicine, LaCrosse, WI; Associate Editor, Sports Health: A Multidisciplinary Approach.

George is an internationally-known speaker who has presented hundreds of conferences throughout the world. He is a clinician, educator, speaker, researcher, author, editor, and consultant. He has been involved in the clinical practice of sports physical ther-

apy/athletic training, since he was a student athletic trainer, over 51 years ago. He also continues to serve as a Consultant and Clinical Mentor of the first publicly credentialed APTA Sports Physical Residency Program in the U.S. at Gundersen Health System Sports Medicine. George has worked at the 1980 Lake Placid Olympics; 2002 Salt Lake Olympics; 2005 Summer World University Games in Izmir, Turkey; 2008 Olympic/Paralympic Games in Beijing, China; and he was invited by the IOC to present educational workshops at the Olympic Village at the 2012 Olympics, London, England. He has a passion for teaching and has been an educator for 45 years in universities; 41 years in physical therapy.

He has been involved in many research projects that have been presented at numerous national and international conferences and published in various journals. He has published over 200 articles and research abstracts in various periodicals, has written several books, and has contributed chapters to over 45 books.

Co-founder and Co-Editor, *The Journal of Orthopaedic and Sports Physical Therapy,* 1979

Co-founder and Co-Editor, *Sports Health: A Multidisciplinary Approach*, 2009

George has been the recipient of several awards including: SPTS-President, 1992-1998; APTA-Baethke-Carlin Award for Excellence in Academic Teaching, 1994; SPTS-Peyton Award, 1999; Coulee Region Officials Association Distinguished Service Award for 25 years of volunteer service to the La Crosse community in the area of sports medicine, 2000; NATA-First Great Lakes Athletic Trainers Association Outstanding Educator Award, 2002; *JOSPT*-George J. Davies-James A. Gould Excellence in Clinical Inquiry Award, 2004; APTA-Fellow American Physical Therapy Association (FAPTA), 2005; SPTS-Hall of Fame, 2006; NATA President's Challenge Award for Outstanding Contributions to Sports Medicine, 2007; NATA Most Distinguished Athletic Trainer Award, 2009; Distinguished Alumni Award from Columbia University, 2012; Armstrong Atlantic State University (AASU), Outstanding Alumnus Award for Outstanding Contributions to Profession, 2012; SPTS- Lifetime Education Achievement Award, 2013; AOSSM-honored as the first non-Orthopaedic Surgeon to be elected into the AOSSM – Hall of Fame, 2013; AASU-H. Dean Propst Award, recognized for outstanding contributions in teaching, advisement, counseling, and the encouragement and support of students' involvement in academic and co-curricular activities, 2014; Keynote Speaker at Singapore National Hospital, Singapore, 2015; Keynote Speaker at the Italian Arthroscopy Association Meeting, Catania, Sicily, 2015; Keynote speaker at the National Physiotherapists Congress, Budapest, Hungry, 2015.

RICHARD W. BOWLING – RICHARD E. ERHARD ORTHOPAEDIC CLINICAL PRACTICE AWARD

This award is given to acknowledge an individual who has made an outstanding and lasting contribution to the clinical practice of orthopaedic physical therapy as exemplified by the professional careers of Richard W. Bowling and Richard E. Erhard. Individuals selected for this award must have been engaged in extensive orthopaedic physical therapy clinical practice for at least 15 years and have positively and substantially affected the shape, scope, and quality of orthopaedic physical therapy practice.

Dr. Snyder-Mackler, PT, ATC, SCS, FAPTA, is an internationally recognized clinician and clinical researcher in sports and orthopedic rehabilitation. She is a Board Certified Sports Physical Therapist who maintains an active Sports Physical Therapy practice at the University of Delaware and serves as a rehabilitation consultant to collegiate, amateur, and professional teams. She served as Head Athletic Trainer for the beach volleyball venue at the 1996 (Centennial) Olympic Games in Atlanta. She concentrates her clinical practice and research in the areas of knee and shoulder rehabilitation, and electrical stimulation of muscle.

She has authored more than 200 research publications in the areas of knee rehabilitation and neuromuscular electrical stimulation and regularly speaks to national and international audiences on these topics. She was named a Catherine Worthingham Fellow of the American Physical Therapy Association in 2003 and Francis Alison Professor at the University of Delaware in 2010. Her research has won several major awards helping patients and practitioners and answering critical questions in sports and orthopaedic rehabilitation including the APTA's Eugene Michels Award, Golden Pen Award, Marian Williams Award, Helen I. Hislop Award, the Orthopaedic Section's Rose Award for Excellence in Orthopaedic Research 3 times, the Ron Peyton Award from the Sports Section, and the John Maley Award from the Section on Research. Her international collaborative research on ACL injuries was awarded a prestigious NIH MERIT Award in 2013. She was named the American Physical Therapy Association's Mary McMilllan Lecturer for 2015, the Association's highest honor.

OUTSTANDING PT STUDENT AWARD

The purpose of this award is to identify a student physical therapist with exceptional scholastic ability and potential for contribution to orthopaedic physical therapy. The eligible student shall excel in academic performance in both the professional and prerequisite phases of his or her educational program, as well as be involved in professional organizations and activities that provide for potential growth and contributions to the profession and orthopaedic physical therapy.

Christopher "Chris" Renfrow, SPT, is currently a 3rd year student in the Doctor of Physical Therapy Program at Regis University, Denver, CO. Prior to beginning his professional education, Chris attended the University of Idaho and graduated Cum Laude with a Bachelors of Science in Biology.

In addition to excelling in his academic and clinical coursework, Chris is immediate Past President of the Colorado Chapter APTA Student Special Interest Group. During his service as President of this group, which represents students from two physical therapy and three physical therapy assistant programs, Chris played a major role in helping the Student SIG organize a continuing education course as well as several other events to raise funds to support physical ther-

apy legislative activities at both the State and National level. In addition, Chris also serves as the AAOMPT Midwest Student Representative and developed the first AAOMPT Student SIG "Fun with Fellows" event to promote student interest in manual therapy. As a result of the essay that he submitted in the Colorado Chapter Advocacy Essay competition, Chris was also selected by the Colorado Chapter APTA Board of Directors to represent the Chapter as its student representative for PT Day on Capitol Hill in Washington, DC. There is little doubt that Chris will be an active player in the advancement of orthopaedic physical therapy following his graduation from Regis University.

OUTSTANDING PTA STUDENT AWARD

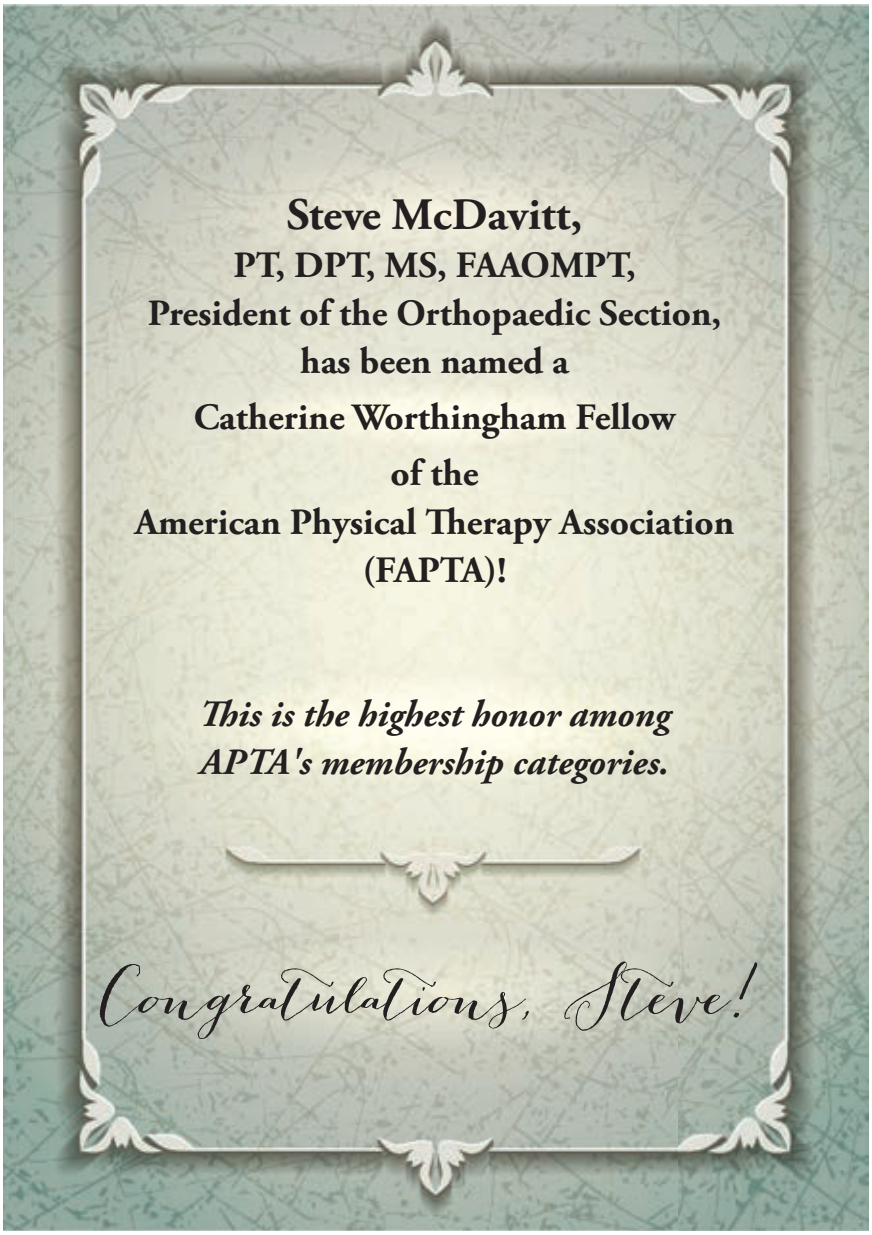
The purpose of this award is to identify a student physical therapist assistant with exceptional scholastic ability and potential for contribution to orthopaedic physical therapy. The eligible student shall excel in academic performance in both the pre-requisite and didactic phases of his or her educational program, and be involved in professional organizations and activities that provide the potential growth and contributions to the profession and orthopaedic physical therapy.

Travis Dills, SPTA, of Somerset, Kentucky is currently a second-year PTA student at Somerset Community College (SCC). Travis serves as President of his class and is a peer mentor and tutor. He was named the winner of a statewide essay competition about the importance of advocacy in health care and, as winner, represented Kentucky at the Federal Advocacy Forum in Washington, DC. He is an active member of the Kentucky Physical Therapy Association (KPTA) and serves as Vice Chair for the KPTA's Student Special Interest Group.

At SCC, he has maintained a perfect 4.00 grade point average and is a member of Phi Theta Kappa Honorary and the Physical Therapy Student Organization. In 2015, he received the highest honor presented within SCC's PTA Program, having been selected the recipient of the James H. Anderson Award. This award is especially meaningful as it is peer-selected and based upon the expectation that the recipient will make a significant and lasting impact upon the physical therapy profession. He was one of only three PTA students in Kentucky to be named to the Kentucky Physical Therapy Association's (KPTA) All-Academic Team in 2015. He is also the recipient of the Mattie Helen Elliot Scholarship and was appointed by the college President to serve on the PTA Program's Advisory Board.

Travis has been active in a number of charitable and community service activities including raising awareness for the importance of organ and tissue donation through activities with the Kentucky Organ Donor Affiliates; presenting about CPR and the Heimlich maneuver at local schools; lecturing to high school students about the importance of being well-prepared to attend college; and fundraising for causes including the Special Olympics and ALS research. He has participated in mission trips to Guatemala and Belize. He has worked as a fitness trainer while enrolled in the program and is currently works at Total Rehab Center in Somerset, Kentucky.

Upon graduation, he plans to work as a physical therapist assistant in Somerset, Kentucky and plans to pursue a DPT degree. He is the son of Mike and Sharon Dills of Somerset.



Book Reviews

Michael J. Wooden, PT, MS, OCS
Book Review Editor

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

Soccer Injury Prevention and Treatment: A Guide to Optimal Performance for Players, Parents, and Coaches, Demos Medical Publishing, 2014, $16.95
ISBN: 9781936303656, 201 pages, Soft Cover

Author: Gallucci, John, Jr., MS, ATC, PT, DPT

Description: This comprehensive book presents clear descriptions of youth and overuse soccer injuries, biomechanical analysis of soccer kicks and headers, and detailed descriptions of injuries by body part, including concussions. It also discusses strength, conditioning, nutrition, and hydration specific to soccer athletes. **Purpose:** The purpose is to provide a detailed look at every joint and the mechanism of injury for soccer injuries, their diagnosis, treatment, and prevention. The book does an exemplary job of presenting the information in layman's terms for the intended audience. **Audience:** As the title indicates, this book is intended for players, parents, and coaches, although it is appropriate for practicing clinicians as well. The author has extensive knowledge in this field as a physical therapist, athletic trainer, and medical coordinator for Major League Soccer. **Features:** The book includes discussions of youth and overuse injuries, as well as injuries of the spine, lower and upper extremity, and concussions. The author also describes prevention principles through strength and conditioning as well as nutrition and hydration. The concussion chapter is excellent and written in layman's terms. From a clinician's perspective, the chapter on youth injury serves as an excellent review of disorders that are not commonly seen in the clinic. As a result, this book can serve as an ongoing resource. Features include a glossary and index, as well as numerous pictures and figures showing exercises and anatomical images of various body regions. **Assessment:** This is an excellent book for soccer players, parents, and coaches. For clinicians, it provides an excellent review of anatomy, injuries, exercise physiology, and exercises that could be used in the clinic and for treating players on the pitch the following day.

Christopher D. Blessing, MS, MPT, OCS, CSCS
University Medical Center of Princeton at Plainsboro

2016 Annual Orthopaedic Section Meeting

Atlanta, Georgia
Grand Hyatt Atlanta-Buckhead
May 5–7, 2016

Treating the Cervical & Lumbar Spine:

Can Art, Science, and Practice Guidelines All Get Along?

It's that time of year again! Time to register for the 4th Annual Orthopaedic Section Meeting, 2016. The meeting will be held in Buckhead-Atlanta, Georgia, May 5-7, 2016. The theme for the meeting is, "Treating the Cervical and Lumbar Spine: Can Art, Science, and Practice Guidelines All Get Along?"

Our focus during the general sessions is to look at the Myths vs. Realities of the Clinical Practice Guidelines (CPGs) During Differential Diagnosis and Clinical Decision Making for the Cervical and Lumbar Spine. We will then transition into the lab-intensive breakout sessions, which will begin with a case study round table discussion and quickly progress into hands-on instruction, demonstration, and practice with the experts in our field.

We have listened to your feedback and have incorporated some positive changes for 2016. Speakers will present in the morning general session and lead the breakout sessions to facilitate greater educational continuity. This will afford participants more time for the hands-on lab sessions and enhance the overall experience. **We are excited to also invite Physical Therapist Assistants to be a part of the Annual Orthopaedic Meeting and to offer an early bird group discount rate.**

Program Information

Thursday, May 5, 2016

Complimentary (Bonus) Session
3:30PM–5:30PM

Lacking Resources to Implement the Didactic Portion of an Orthopaedic Residency Program? The Section's "Curriculum Package" Can be the Answer you are Looking For!
Speakers: Kathryn R. Cieslak, PT, MS, DSc, OCS; Aimee Klein, PT, DPT, DSc, OCS

Keynote Presentation & Opening Reception: 6:00 PM–9:00 PM

Practice Guidelines and Care Pathways: Moving the Practice of Physical Therapy Forward
Speaker: Julie Fritz, PT, PhD, FAPTA

Friday, May 6, 2016

Friday Schedule: 8:00AM–4:30PM
General Session: 8:00AM–10:30AM

The Neck Pain Clinical Practice Guideline: Strengths, Limitations, and Recommendations for the Future
Speakers: Joshua Cleland, PT, PhD, OCS; Robert Landel, PT, DPT, OCS, FAPTA; Paul Mintken, DPT, OCS, FAAOMPT; Kenneth Olson, PT, DHSc, OCS, FAAOMPT

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

Breakout Session 1:
Examination and Treatment of Neck Pain with Radiating/Referred Symptoms
Speaker: Joshua Cleland, PT, PhD, OCS

Breakout Session 2:
Examination and Treatment of Neck Pain with Headache
Speaker: Robert Landel, PT, DPT, OCS, FAPTA

Breakout Session 3:
Examination and Treatment of Individuals with Neck Pain with Movement Coordination Impairments
Speaker: Paul Mintken, DPT, OCS, FAAOMPT

Learn More

The 2016 Annual Orthopaedic Section Meeting will be held at the beautiful Grand Hyatt Atlanta-Buckhead in Atlanta, Georgia. The Grand Hyatt is located on Peachtree Street in the heart of Atlanta's upscale Buckhead neighborhood. Visit the following link for full meeting details, to register, and to reserve your guestroom: *https://www.orthopt.org/content/c/2016_annual_orthopaedic_section_meeting*

Breakout Session 4:
Examination and Treatment of Neck Pain with Mobility Deficits
Speaker: Kenneth Olson, PT, DHSc, FAAOMPT, OCS

Saturday, May 7, 2016

Saturday Schedule: 7:45AM–4:45PM
General Session: 7:45AM–10:15AM

Myths and Realities of the Lumbar Spine Clinical Practice Guidelines: Content Update and Techniques for Focusing Examination and Treatment to Match the Demands of Clinical Practice
Speakers: Chad Cook, PT, PhD, MBA, FAAOMPT; Anthony Delitto, PT, PhD, FAPTA; Jake Magel, PT, PhD, DSc, OCS, FAAOMPT; Sheri Silfies, PT, PhD; Michael Timko, PT, MS, FAAOMPT

Concurrent Breakout Sessions:
Following the general session on Saturday, four concurrent breakout sessions will be offered. The registrant will attend three out of four breakout sessions following the morning general session, based on order of preference indicated on the registration form. Note: space is limited, and therefore the attendeeís breakout session assignments will be given on a first-come, first-serve basis.

Breakout Session 5:
Physical and Cognitive Behavioral Exercise to Influence Chronic Centrally Mediated Pain
Speaker: Chad Cook, PT, PhD, MBA, FAAOMPT

Breakout Session 6:
Mobility Impairments of the Lumbar Spine
Speaker: Jake Magel, PT, PhD, DSc, OCS, FAAOMPT

Breakout Session 7:
Motor Control/Movement Coordination Impairment of the Lumbar Spine & Pelvis
Speaker: Sheri Silfies, PT, PhD

Breakout Session 8:
Applied Examination Principles and Differential Diagnostic Considerations for the Lower Quarter
Speaker: Michael Timko, PT, MS, FAAOMPT

Saturday Mid-Day: "Lunch-and-Learn"

12:30PM–1:15PM

Clinical Practice - Future Directions
Speaker: Joseph Godges, DPT, MA, OCS

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

Message from the OHSIG

The election results were announced at the Membership Meeting in Anaheim at the Combined Sections Meeting. Lorena P. Payne was elected for a second 3-year term as President and Lori Deal was elected to the Nominating Committee. Jill Galper was honored for her many years of service with the OHSIG.

Becoming a member of the Occupational Health Special Interest Group is a benefit of your Orthopaedic Section membership. You can sign up on the Orthopaedic Section website under the OHSIG. Don't forget to check out the conversations taking place on the closed "Occupational Health SIG" Facebook page. Just ask to join!

Physical Therapy Early Intervention in the Work Place

Daniel Dudek, PT, DPT, CMT, MS, ATC
Michael Morgan, PT, DPT
Chris Studebaker, PT, DPT, OCS
Sarah Stultz, PT, OCS, FAAOMPT
Shelby Warner PT, FAAOMPT, CSCS

Concentra Medical Centers of Illinois, Arizona, South Carolina, Texas, and Florida

In an increasingly competitive global market place, companies are constantly searching for new ways to reduce expenses. As worker's compensation (WC) costs have a significant impact on the bottom line of many businesses, reducing the incidence and severity of work-related musculoskeletal disorders (WRMSDs) has become an area of great interest for many employers. Work-related musculoskeletal disorders accounted for 32% of all injury and illness cases in 2014. In addition, there were over 350,000 cases of WRMSDs in the workplace, requiring an average of 13 days of lost time or limited duty in 2014.[1] America spends an estimated $45 to 54 billion annually for WRMSDs.[2] While the overall numbers of injuries have remained relatively stable over the last few years, the cost to manage MSDs has continued to rise, especially for the spine.[3] One hypothesis points to an increase in the use of specialists and diagnostic imaging in the last decade that has resulted in increased costs, despite a lack of evidence to support their use.[4]

As the staggering costs of WRMSDs negatively impact their bottom line, many companies have begun to explore new and novel methods for the management of worker injuries. Some employers have sought to prevent MSDs from ever happening by promoting wellness and preventative services or redesigning the work environment with ergonomic improvements. Others have attempted to find innovative ways to treat injuries after they occur by managing musculoskeletal injuries on-site, with telemedicine, or by using alternative health care practitioners.

Today, more and more employers are looking to expand the role of physical therapy (PT) as a means of reducing work injury cost and disability. In addition to traditional outpatient rehabilitation, physical therapists have increasingly become providers of occupational health services, ranging from wellness and prevention, ergonomics, and pre-employment testing, to early MSD reporting programs and on-site patient care. As experts in rehabilitation services for injured workers, therapists are often called upon to provide interventions that improve functional status and work tolerance in traditional outpatient clinic and on-site settings.

In the past many medical providers, employers, and payers have preferred to delay PT in the hope that injuries would resolve on their own during the initial phase following an injury. This "wait and see" approach has been generally considered to be a method to reduce WC expense by avoiding the cost of therapy. Despite the assumption that delaying PT can save money, research supports the use of early administration of PT for the management of WRMSDs.[5-9] These studies have demonstrated that early, aggressive, active functional rehabilitation improves patient outcomes and reduces overall MSD case costs by reducing the need for other, at times more expensive and less effective, treatments for many workers.[5-9]

Recently there has been a growing body of evidence that supports the use of an early intervention model that is predicated on prompt and active treatment of musculoskeletal injuries similar to a sports medicine approach, in which workers begin treatment as soon as possible, often on the same day as their injury.[5-9] The early intervention model is based upon the contention that the sooner an effective plan of care can be established, the more likely the patient will have a positive response to the intervention, a decrease in fear avoidance behaviors, less negative physiologic changes in response to decreased mobility, less time away from work, and, ultimately, a decrease in the overall likelihood of more invasive procedures.

DISUSE AND EARLY INTERVENTION

Both acute and chronic injuries can result in significant physical, social, and psychological adaptations that can negatively impact the short, and even long-term, outcomes for an injured worker. At times it may seem intuitive to take it easy, and rest sprained ankles, strained backs, and other WRMSDs to allow the body to heal. However, soon after a worker begins to limit the use of an injured body part, physiological changes begin that can impact the neuromusculoskeletal system in ways that can negatively impact patient outcomes.

Like an injured athlete who cannot train or compete, it is easy to envision a worker losing muscle strength or aerobic conditioning after a prolonged absence from work. However, it is less intuitive to patients and employers that the central nervous system begins to modify the motor cortex to accommodate to the injury as well as the musculoskeletal system. There is evidence to suggest that the disuse that can follow an injury can result in neuroplastic changes to the M1 region of the motor cortex that is associated with the injured body part.[10] Neural plasticity appears to be an "intrinsic property of the brain"

that "takes place in response to afferent input and/or efferent demand," allowing the brain to adapt to the activity or inactivity in which a person engages.[10] When a person or animal engages in or ceases to execute a physical activity, the motor map of the cerebral cortex can change. While these changes are typically reversible, they may alter movement patterns of the patient and contribute to longer term adaptations that can impede a return to normal activity and function.[11-14]

In addition to neuroplastic remodeling, changes to the soft tissues of the worker can begin soon after injury as well. When a worker limits the use of a sprained wrist by avoiding wrist motion, or keeps a sprained ankle immobilized, then the typical patterns of loading through tendons, muscles, ligaments, and even joint surfaces are altered. This reduced use can adversely impact the tissues of the body that depend on compressive and tensile loads to maintain their structure. Without tensile loading through tendons and ligaments, for instance, the ability to maintain glycosaminoglycan production diminishes.

Similarly, the reduction in physiological loading that accompanies disuse can cause significant changes in muscle. If a musculoskeletal unit does not forcefully contract for a long enough period of time, atrophy will ensue that can limit a worker's ability to return to the job. In addition, more insidious neurological effects can occur as well such as reduced proprioception and a decrease in nerve conduction to the muscle fibers.[1] A loss of general endurance and conditioning can also occur after a WRMSD that can impact functional status, especially when workers are away from the physical requirements of the job for an extended period of time.

As with physical changes to the musculoskeletal system, psychosocial issues can also begin to affect the functional status of workers soon after the onset of injury. When patients are sidelined from the regular activities of their job, home life, and leisure activities, they often experience frustration and, at times, even depression and anger. Workers may also develop a disproportionate disinclination towards activity and movement (fear avoidance beliefs) that can negatively impact their recovery. Recent studies have reported that high fear avoidance beliefs are associated with poor recovery, increased risk of prolonged absence from work, and even disability.[16]

The early application of PT can help to combat the psychosocial impact of WRMSDs. The early application of therapy interventions such as patient education about pathophysiology, pain management, appropriate physical activity, and home exercises coupled with skilled treatment, such as mobilization and therapeutic exercise, can reduce fear avoidance beliefs.[17] A positive experience that incorporates patient education on how and why early movement is important will facilitate a positive early engagement by the patient during the rehabilitative process. Additionally, findings suggest early therapy treatment leads to improved outcomes in disability, general health, social function, anxiety, depressive symptoms, mental health, and vitality.[18]

Wand et al[18] studied the impact of the timing of PT on biopsychosocial effects of injuries. In this randomized clinical trial, 100 patients with acute low back pain (LBP) were randomized into two groups. Both groups received information about the benefits of staying active and focused on function instead of pain during their medical examination. The early intervention group received PT immediately following the medical visit, whereas the late intervention group received PT 6 weeks later. The PT intervention included both low and high velocity manipulation techniques, dependent on the discretion of the therapist. The outcome measurements used in this study were based on the Roland and Morris Disability Questionnaire.

At the 6-week follow-up, the early treatment group had "significantly lower disability and fewer symptoms of depression and anxiety and had better quality of life, vitality, social functioning, and mental health" compared to the group that received PT after 6 weeks. At the 6-month follow-up, the PT intervention group had "less depression, somatic distress, and anxiety, had better quality of life and mental health, and reported less interference of emotional problems in everyday activities than the later PT intervention group."[18]

When treating WRMSDs limiting loss time from work is essential. The early use of PT has also been shown to improve the speed of recovery for the patient. A study by Linz et al[19] examining the effectiveness of occupational medicine center-based PT showed a mean number of PT visits to be 45% less than a national bench mark (mean visits 5.7 vs. 10.5). Eighty-two percent of the early group started PT within 6 days of injury, with 42% starting on the date of injury. Return-to-work outcomes at discharge from PT showed that 94% had returned to work.

EFFECT ON THE USE OF OTHER INTERVENTIONS AND SPECIALIST VISITS

The early use of PT may not only positively affect the psychosocial impact of worker injury, but may also reduce the use of more expensive diagnostic imaging and other interventions such as steroid injections, prescription pain medication, and surgery. An estimated 53.9 million people in the United States report having one or more musculoskeletal disorders. These musculoskeletal disorders represent some of the leading causes of restricted activity days across the United States, with spinal disorders comprising the most expensive musculoskeletal region of the body. Increasing costs of care are highly correlated with a rise in prevalence of diagnostic imaging, spinal injections, surgeries, and opioid medication.

While at times necessary, injections and surgery come with a significant amount of risk for iatrogenic complications. In addition, opioid medications and other painkillers can have significant side effects and pose the risk of addiction. These interventions may be associated with longer periods of lost work days and a reduced quality of life.[16] Beyond just the associated risk of these more invasive treatments for WRMSDs, they can also have a significant impact on the overall cost of a case. Deyo et al[20] found a 108% increase in prescription opioid use for patients with LBP, resulting in a 423% inflation-adjusted increase in expenditure. They also determined that over 50% of regular prescription opioid users have an ICD-9 code associated with LBP.[20] Despite the rise in use of opioids, Deshpande et al[3] performed a systematic review in 2009 and found that benefits for opioid use in LBP was moderate at best. In addition, opioid use for acute LBP was found to correlate with poorer functional outcomes and subsequent long-term use.

Systematic reviews of lumbar fusion outcomes in WC patient populations have shown mixed results for efficacy. Recent studies on lumbar fusions in the WC setting have reported return-to-work rates of 26% to 36%, re-operation rates of 22% to 27%, and high rates of persistent opioid use two years after surgery. Other types of lumbar surgery in WC populations are

also acknowledged to have poorer outcomes than in non-WC.[21] Likewise, injections have been found to have questionable long-term benefit for WRMSDs for many conditions. While beneficial in the short term for some conditions, concerns have been raised that steroid injections may worsen outcomes long term for some tendinopathies.[22] Limited evidence also exists to support epidural corticosteroid injections for many types of LBP.[23]

The role of diagnostic imaging for LBP has come under increased scrutiny due to increase costs and lack of associated improvement in patient outcomes. A study by Battie et al[24] demonstrated that there appears to be some relation between genetics, body build, and early environmental influences in determining the degenerative changes of the spine frequently associated with aging. Degenerative changes on magnetic resonance imaging, myelography, and computer-assisted tomography, however, are not strongly related to LBP symptoms.[24] Current recommendations from the American College of Physicians are that (1) imaging is only indicated for severe progressive neurological deficits or when red flags are suspected, and (2) routine imaging does not result in clinical benefit and may lead to harm.[23]

In 2012, a large retrospective cohort study was conducted by Fritz et al that looked to examine the effect of early PT on the utilization of other interventions and opioid use. They examined a national database of employer-sponsored health plans with a total of 32,070 patients with an initial consultation to a primary care provider for an ICD-9 associated with LBP, all of whom had been seen by a physical therapist within 90 days. Subjects were then categorized into having been seen in PT within 14 days (early PT group) or after 14 days (delayed PT group). They closely examined the utilization of specific services for LBP in the 18 months following their initial primary care consultation. The study found that the early therapy group underwent fewer advanced imaging studies, received fewer spinal injections, used fewer opioid medications, and underwent fewer spinal surgeries than those who had delayed PT. They concluded that total medical costs for LBP were $2,736.23 lower for patients receiving early PT.[25]

Similarly, Gellhorn et al[26] examined the effect of early PT on the use of other medical procedures for LBP. A total of 439,195 patients were identified through the Center for Medicare and Medicaid Services physicians' outpatient claims datasets who had been treated in 2003-2004 with a primary diagnosis of LBP without having treatment in the prior 6 months. Patients receiving PT in the acute (within 30 days) or subacute phase (31-90 days) were less likely to have surgery compared to patents receiving PT in the chronic phase (greater than 90 days). Early PT was associated with less health care consumption as participants had fewer lumbosacral injections, physician office visits for LBP, and lumbar surgery.[26]

Childs et al[27] also reported a relationship between early PT and reduced health care use. This study included 122,723 patients who went to a primary care physician following an initial LBP episode and received PT within 90 days. Of these patients, 17,175 received early PT (within 14 days) that adhered to guidelines for active treatment. During a two-year time period, these patients had significantly less use of advanced imaging, lumbar spinal injections, lumbar spine surgery, and opioids than the patients who received other combinations of timing and adherence. Early PT patients also had 60% lower LBP-related costs as compared to 33.5% (23,993) of patients who had delayed and adherent PT (between 14 and 90 days).[27]

ABSENTEEISM, PRESENTEEISM, AND THE FINANCIAL IMPLICATIONS OF EARLY INTERVENTION

In addition to reducing the use of imaging, injections, and other medical interventions, early PT has also been shown to aid in the reduction of lost work time and presenteeism for injured workers. Returning an injured worker to regular duty is a key goal for most employees and employers alike. Workers that are out of work or who are on restricted duty often wish for a return to their regular role as much as their employers do. Being out of work, or working "light duty," often carries with it significant financial hardship and, at times, social stigma for the worker. When looking at overall case cost, it has been reported that 66% of the total case costs are secondary to indemnity cost. Employer's bottom lines are negatively impacted by having to pay a worker who is out due to restrictions or who is working outside of their normal role. Therefore, effectively and efficiently rehabilitating a patient to a level of strength, endurance, and activity tolerance in which they can safely and sustainably perform the essential functions of his or her job is of paramount importance. In order to accomplish this, it has been shown that the timing of PT is an important factor in the rehabilitation process.

Ehrmann-Feldman et al[28] presented data that showed patients referred to PT within the first month following injury tended to return to work within a relatively short period of time, thereby reducing lost work days. Receiving PT within one month of the work injury was a strong predictor of return to work within two months of the back injury. Subjects in this study only had one episode of back pain. Absence from work for less than 60 days was labeled as "early return to work," whereas absence from work for greater than 60 days was labeled as "late return to work." Early PT was defined as PT within 30 days following the date of injury, while the other group was subjects not receiving PT or referred after 30 days from the initial date of injury.[28]

Hagen et al[29] studied the use of early intervention program's impact on reducing long-term sick leave for LBP. Patients ranged in age from 18 to 60 and experienced a sick leave of 8 to 12 weeks. At a 3-month follow-up assessment, 51.9% of the patients in the early intervention group returned to full duty, as compared to 35.9% in the control group. At the 12-month follow-up assessment, 68.4% in the early intervention group had returned to full duty work, as compared to 56.4% in the control group.[29] Arnetz et al[30] reported that early workplace intervention showed significantly decreased mean sick days as compared to the reference group. In this study, patients with physician-diag-

nosed MSDs were randomized either to the intervention group or the reference group. The direct cost savings were $1195 per case, yielding a direct benefit-to-cost ratio of 6.8.[30]

The Fritz et al[25] and Childs et al[27] studies reported similar cost savings. One reported that costs were $2736.23 lower ($3661.78 vs $1810.67) for patients receiving early PT whereas the other study showed a $1202.29 lower ($3030.53 vs $1828.24) mean than delayed care. In both studies, PT was used within 90 days of the initial physician visit.[25,27] A study by Gatchel et al[31] also revealed greater cost savings associated with early intervention compared to a non-intervention group. Both therapeutic and financial advantages of an early intervention approach to acute LBP disability were clearly demonstrated.[31] The results of a study by Pinnington et al[32] showed early intervention with PT in primary care cost less per episode of care versus conventional management for patients with LBP. A majority of the patients included in this study were able to initiate PT within 3 to 4 days.[32]

PHYSICAL THERAPY REFERRAL AND UTILIZATION

Despite the evidence in support of therapy, and more specifically an early intervention model, to treat MSDs, physicians often use the "wait and see" approach to managing injuries. In a study on practice patterns for ankle sprain, only 9% of physicians surveyed reported that they frequently considered referring patients to PT despite evidence to support early mobilization of acute ankle sprains.[34] Published guidelines on knee osteoarthritis provide good evidence to support exercise and strengthening interventions, but do not specify whether patients should be referred immediately for these interventions or initially managed with pharmacology.[16] Employers also commonly view PT as an intervention that should be administered later in the course of care. Many employers and patients view PT as a means of rehabilitating MSDs "after they have had time to heal" instead of as a frontline means of reducing long-term disability. Although research demonstrates that early PT can lead to both greater cost savings and improved patient outcomes, at times employers are quick to argue that PT is over-used and increases the cost of care for their workers.

At times, physical therapists that work with the injured worker population must then act as educators to referral sources, employers, patients, and to payers. Therapists can play a key role in explaining to these stakeholders that initiating PT earlier can save them money, prevent worker disability, and reduce lost time and presenteeism. This can allow employers and their insurers to may make more effective decisions when it comes to authorizing therapy early in the course of care instead of waiting until the negative impacts of disuse have already begun to set in. Likewise, therapists in this setting can collaborate with physicians and other referral sources, demonstrating to them the value of not only early intervention, but also of therapy in general, in the management of WRMSDs. Therapists in the occupational health setting have the ability to demonstrate their high level of expertise as not only clinicians but also as components of the return-to-work process. Educating physicians and other referral sources about the expertise of therapists as orthopaedic clinicians can enhance their understanding of the value of PT. Research has shown that the more physicians know about PT and about orthopaedic care, the more likely they are to refer to PT.[34,35]

CONCLUSION

Despite the fact that patients, employers, payers, and at times, medical providers often wish to take a "wait and see" approach to managing WRMSDs, the previously cited evidence supports the early use of PT for the management of injuries. Therapists that work in the occupational health setting, either in outpatient clinics or on-site, often have the ability to inform stake holders about the benefit of initiating therapy early in the course of an injury to optimize patient care and improve case outcomes. Currently, many companies have instituted aggressive early reporting programs that rely upon this concept to manage WRMSDs before they lead to serious, long-term injuries. By adhering to this sports medicine model of early treatment, early return-to-work, early motivation, and empowerment of the patient, companies have reduced injury costs and worker disability.

With escalating health care costs relating to WC, it is crucial to effectively manage cases to optimize both patient and employer outcomes. Therapists can optimize worker injury management by educating employers, workers, payers, and referral sources about the benefits and cost-effectiveness of providing therapy as soon as possible after an injury.

REFERENCES

1. Bureau of Labor Statistics. Nonfatal Occupational Injuries and Illnesses Requiring Days Away From Work, 2014. http://www.bls.gov/news.release/pdf/osh2.pdf. Accessed February 2,-2016.
2. National Research Council, Institute of Medicine. *Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities.* Washington, DC: National Academies Press; 2001.
3. Deshpande A, Furlan A, Mailis-Gagnon A, Atlas S, Turk D. Opioids for chronic low-back pain. *Cochrane Database Syst Rev*. 2007;(3):CD004959.
4. Mafi JN, McCarthy EP, Davis RB, Landon BE. Worsening trends in the management and treatment of back pain. *JAMA Intern Med*. 2013;173(17):1573-1581. doi: 10.1001/jamainternmed.2013.8992.
5. van der Wees PJ, Lenssen AF, Hendricks EJ, Stomp DJ, Dekker J, de Bie RA. Effectiveness of exercise therapy and manual mobilisation in acute ankle sprain and functional instability: A systematic review. *Aust J Physiother*. 2006;52(1):27-37.
6. Keane GP, Saal JA. The sports medicine approach to occupational low back pain. *West J Med*. 1991;154(5):525-527.
7. Wand BM, Bird C, McAuley JH, Dore CJ, MacDowell M, De Souza LH. Early intervention for the management of acute low back pain: a single-blind randomized controlled trial of biopsychosocial education, manual therapy, and exercise. *Spine (Philadelphia Pa 1976)*. 2004;29(21):2350-2356.
8. Ogilvie-Harris DJ, Gilbart M. Treatment modalities for soft tissue injuries of the ankle: a critical review. *Clin J Sport Med*. 1995;5(3):175-186.
9. Eiff MP, Smith AT, Smith GE. Early mobilization versus immobilization in the treatment of lateral ankle sprains. *Am J Sports Med*. 1994;22(1):83-88.
10. Svensson P, Romaniello A, Arendt-Nielson L, Sessle BJ. Plasticity in corticomotor control of the human tongue musculature induced by tongue-task training. *Exp Brain Res*. 2003;152(1):42-51. Epub 2003 Jun 26.

11. Risberg MA, Beynnon BA, Peura GD, Uh BS. Proprioception after anterior cruciate ligament reconstruction with and without bracing. *Knee Surg Sports Traumatol Arthrosc*. 1999;7(5):303-309.
12. Lundbye-Jensen J, Nielson JB. Central Nervous adaptations following 1 wk of wrist and hand immobilization. *J Appl Physiol (1985)*. 2008;105(1): 139-151. doi: 10.1152/japplphysiol.00687.2007. Epub 2008 May 1.
13. Nudo RJ. Neural bases of recovery after brain injury. *J Commun Disord*. 2011;44(5):515-520. doi: 10.1016/j.jcomdis.2011.04.004. Epub 2011 Apr 30.
14. Kleim JA. Neural plasticity and neurorehabilitation: teaching the new brain old tricks. *J Commun Disord*. 2011;44(5):521-528. doi: 10.1016/j.jcomdis.2011.04.006. Epub 2011 Apr 30.
15. Appell HJ. Muscle atrophy following immobilization. *Sports Med*. 1990;10(1):42-58.
16. Ojha HA, Nadia JW, Davenport TE, Eagan WE, Gellhorn AC. Timing of physical therapy initiation for nonsurgical management of musculoskeletal disorders and effects on patient outcomes: a systematic review. *J Orthop Sports Phys Therapy.* 2016; 46(2):56-70. doi: 10.2519/jospt.2016.6138. Epub 2016 Jan 11.
17. Godges JJ, Anger MA, Zimmerman G, Delitto A. Effects of education on return-to-work status for people with fear-avoidance beliefs and acute low back pain. *Phys Ther*. 2008;88(2):231-239. Epub 2007 Dec 4.
18. Wand BM, Bird C, McAuley JH, Dore CJ, MacDowell M, De Souza LH. Early intervention for the management of acute low back pain: a single-blind randomized controlled trial of biopsychosocial education, manual therapy, and exercise. *Spine (Phila Pa 1976)*. 2004; 29(21): 2350-2356.
19. Linz DH, Shepherd CD, Ford LF, Ringley LL, Klekamp J, Duncan, JM. Effectiveness of occupational medicine center-based physical therapy. *J Occup Environ Med*. 2002;44(1):48-53.
20. Deyo RA, Mirza SK, Turner JA, Martin BI. Overtreating chronic low back pain: time to back off? *J Am Board Fam Med*. 2009;22(1):62-68. doi: 10.3122/jabfm.2009.01.080102.
21. Mayer TG, Gatchel RJ, Brede E, Theodore BR. Lumbar surgery in work-related chronic low back pain: can a continuum of care enhance outcomes. *Spine J*. 2014;14(2):263–273. doi: 10.1016/j.spinee.2013.10.041. Epub 2013 Nov 12.
22. Coombes BK, Bisset L, Vicenzino B. Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials. *Lancet*. 2010;376(9754):1751-1767. doi: 10.1016/S0140-6736(10)61160-9. Epub 2010 Oct 21.
23. Chou R, Qaseem A, Owens DK, Shekelle P; Clinical Guidelines Committee of the American College of Physicians. Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. *Ann Intern Med*. 2011; 154(3):181-189. doi: 10.7326/0003-4819-154-3-201102010-00008.
24. Battie MC, Videman T, Kaprio J, et al. The Twin Spine Study: contributions to a changing view of disc degeneration. *Spine J*. 2009;9(1):47-59. doi: 10.1016/j.spinee.2008.11.011.
25. Fritz JM, Childs JD, Wainner RS, Flynn TW. Primary care referral of patients with low back pain to physical therapy: impact on future health care utilization and costs. *Spine (Phila Pa 1976)*. 2012;37(25):2114-2121. doi: 10.1097/BRS.0b013e31825d32f5.
26. Gellhorn AC, Chan L, Martin B, Friedly J. Management patterns in acute low back pain: the role of physical therapy. *Spine*. 2012;37(9):775-782. doi: 10.1097/BRS.0b013e3181d79a09.
27. Childs JD, Fritz JM, Wu SS, et al. Implications of early and guideline adherent physical therapy for low back pain on utilization and costs. *BMC Health Serv Res*. 2015;15:150. doi: 10.1186/s12913-015-0830-3.
28. Ehrmann-Feldman D, Rossignol M, Abenhaim L, Gobeille D. Physician referral to physical therapy in a cohort of workers compensated for low back pain. *Phys Ther*. 1996;76(2):150-156; discussion 156-157.
29. Hagen EM, Eriksen HR, Ursin H. Does early intervention with a light mobilization program reduce long-term sick leave for low back pain? *Spine (Phila Pa 1976)*. 2000;25(15):1973-1976.
30. Arnetz BB, Sjogren B, Rydehn B, Meisel R. Early workplace intervention for employees with musculoskeletal-related absenteeism: a prospective controlled intervention study. *J Occup Environ Med*. 2003; 45:499-506.
31. Gatchel RJ, Polatin PB, Noe C, Gardea M, Pulliam C, Thompson J. Treatment-and cost-effectiveness of early intervention for acute low-back pain patients; a one-year prospective study. *J Occup Rehabil*. 2003;13(1):1-9.
32. Pinnington MA, Miller J, Stanley I. An evaluation of prompt access to physiotherapy in management of low back pain in primary care. *Fam Pract*. 2004;21(4):372-380.
33. Seah R, Mani-Babu S. Managing ankle sprains in primary care: what is best practice? A systematic review of the last 10 years of evidence. *Br Med Bull*. 2011;97:105–135. doi: 10.1093/bmb/ldq028. Epub 2010 Aug 14.
34. Freburger JK, Holmes GM, Care TS. Physician referral to physical therapy for the treatment of musculoskeletal conditions. *Arch Phys Med Rehabil*. 2003;84(12):1839-1849.
35. Stanton PE, Fox FK, Frangos KM, Hoover DH, Spilecki GM. Assessment of resident physicians' knowledge of physical therapy. *Phys Ther*. 1985;65(1):27-30.

PERFORMING ARTS

SPECIAL INTEREST GROUP

President's Letter

Annette Karim, PT, DPT, OCS, FAAOMPT

The Performing Arts Special Interest Group is in full swing! We had a great time at CSM with a preconference course, our regular PASIG session, and a good business meeting. We awarded a student scholarship to Susan Kokot and her team for their platform presentation on "Prediction of Injuries at a Dance Medicine Walk-In Clinic During a Summer Dance Intensive."

We look forward to providing more programming at conferences in 2017. Upcoming events for the Orthopaedic Section are the 2016 Annual Conference on May 5-7, in Atlanta, Georgia, and CSM 2017 on February 15-17 in San Antonio, TX. The 2107 Annual Orthopaedic Section Meeting will be at the San Diego Hyatt Regency Mission Bay April 20-22. Please contact Rosie Canizares, our new Vice President and Education Chair with your interest.

Please welcome our new PASIG board members! There is room for new committee members, and students are welcome to participate. Please refer to the list below for contact information.

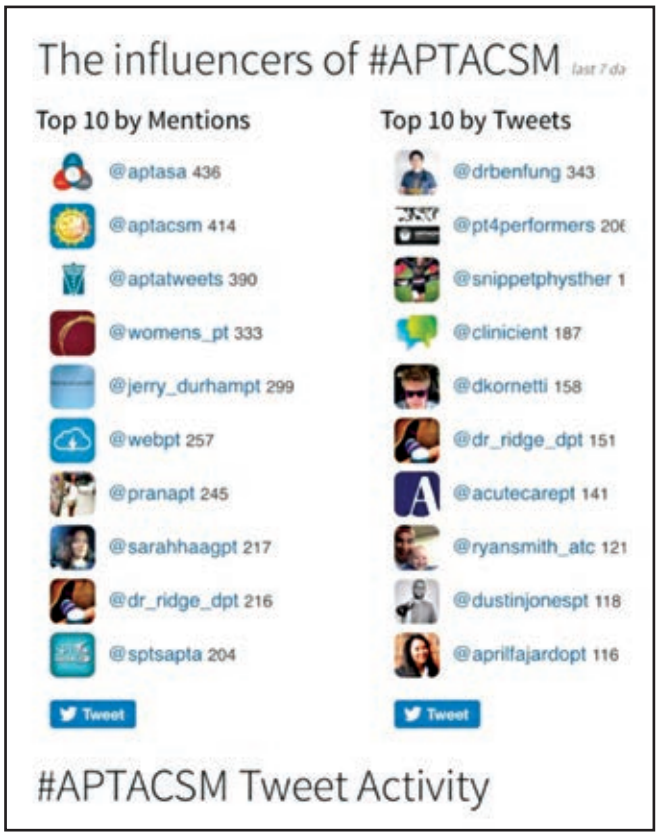
Interested in a Performing Arts Fellowship? The American Board of Physical Therapy Residency and Fellowship Education (ABPTFRE) has approved the PASIG Description of Specialist Practice (DSP) for the Performing Arts as an area of study. We are now working with the ABPTFRE to turn the DSP into a Description of Fellowship Practice (DFP). We anticipate the DFP will be available online by June 2016. This means that sites can begin forming fellowships in dance medicine, music medicine, theater medicine, etc. The PASIG will provide the fellowship criteria for accreditation. We may have a course on creating a performing arts fellowship at CSM 2017 and/or the 2017 Orthopaedic Section Annual Meeting. Please contact Rosie Canizares, Mariah Nierman, and Laurel Abbruzzese if interested.

Interested in the PASIG? Membership to the PASIG is free to Orthopaedic Section members: https://www.orthopt.org/sig_pa_join.php

If you are already a member, please remember to update your membership:

https://www.orthopt.org/login.php?forward_url=/surveys/membership_directory.php

Keep up with us on FaceBook by contacting Dawn Doran. It is a closed group, so you need to contact Dawn first. Keep up with us and post on Twitter: We are PT4Performers.



Interested in dancer screening? We are collecting pre-professional dance screens for our members to use. If you would like to contribute to the collection, please contact Mandy Blackmon. For professional screening, we recommend Dance USA's Task Force on Dancer Health: https://www.danceusa.org/dancerhealth

Annette Karim, President	2014-2017	neoluvsonlyme@aol.com
Rosie Canizares, Vice President/Education Chair	2016-2019	Rcc4@duke.edu
Janice Ying, Nominating Committee Chair	2016-2017	JaniceYingDPT@gmail.com
Laura Reising, Research Chair	2016-2018	lbreising@gmail.com
Amanda Blackmon, Dancer Screen Chair	2016-2018	MandyDancePT@gmail.com
Dawn Muci, Public Relations Chair	2016-2018	Dawnd76@hotmail.com
Mariah Nierman, Fellowship Task Force Chair	2016-2018	Mariah.Nierman@osumc.ed
Anna Saunders, Secretary/Student Scholarship Chair	2015-2017	annarosemary@gmail.com
Andrea N. Lasner, Nominating Committee	2015-2018	alasner1@jhmi.edu
Jessica Fulton, Nominating Committee	2016-2019	jessicafultondpt@gmail.com
Laurel Abbruzzese, Fellowship Chair Asst.	2016-2018	La110@cumc.columbia.edu
Elizabeth Chesarek, Membership Chair	2016-2018	echesarek@gmail.com

We are looking for authors for the PASIG newsletter in the *Orthopaedic Physical Therapy Practice* quarterly magazine. The following section is a tutorial on how to start.

How to Write for the PASIG Newsletter

Annette Karim, PT, DPT, OCS, FAAOMPT

Clinicians, students, and faculty can contribute to the content of the PASIG newsletter pages. The content should be clinically-oriented. The best way to begin is to start with a patient you are treating, or a question that has been nagging you for some time. You can use the PICO method as one way to begin your investigation. There were some very good student capstone PASIG platforms and posters at CSM using this method to develop a literature review. The method works for clinicians too! I will demonstrate as follows:

1. Pick a Population or Problem (P)
2. Pick an intervention (I)
3. Pick a comparison (C)
4. Pick an outcome (O)

1. **P:** I am treating a 24-year-old aerialist who experienced 8/10 low back pain (LBP) after practicing on silks two days ago, and is unable to walk, stand, or sit more than 15 minutes because of her LBP.
2. **I:** I would like to investigate the dynamic neuromuscular stabilization (DNS) supine 3 month breathing techniques for lumbar stabilization.
3. **C:** I would like to compare the DNS technique to the prone abdominal drawing-in maneuver (ADIM) with a blood pressure cuff for lumbar stabilization.
4. **O:** I will use the Oswestry Disability Index (ODI) in the clinic for my pre- and post-intervention outcome measure. I will also use the Numerical Pain Rating Scale (NPRS) as a self report-measure of pain.

My question is: "Will DNS be more effective than ADIM as a lumbar stabilization treatment for the improvement in function as measured by the ODI, and the reduction of pain as measured by the NPRS in a 24-year-old aerialist who experiences 8/10 LBP?"

What I would do from here is decide on a case report, a case series, a randomized-controlled trial, or a literature review. If there is any kind of intentional variation in interventions for study purposes, you will need a review from an institutional review board (IRB). If a literature review, or a simple case report, there is no need for an IRB.

Next I would start my literature search through Google Scholar: https://scholar.google.com

I would look up aerialist AND low back pain, aerialist AND injury, low back pain AND abdominal drawing-in maneuver, dynamic neuromuscular stabilization, low back pain and breathing, and Oswestry Disability Index separately as a start. When I search aerialist AND low back pain, I got nothing. So I changed my search to contortionist and low back pain, and got much more. Google Scholar will give you articles and when you press "cite" you will get a list of formats to choose from for citing. Pick APA. At the bottom of the pop-up window, there will be several choices of citation managers if you have them. As I conduct my preliminary search, I would start saving my articles and labeling them through a citation manager, or cut/paste the citation into a separate Word document. When I read my articles, I will summarize each by author, purpose, population/age, study design/length, results, and clinical application. Then I use that information to choose the best intervention for my patient. I could compare my outcomes pre/post-intervention in the same aerialist. I could compare to outcomes of aerialists from the same group and age with the same type of low back pain but used the other intervention in a retrospective analysis, matching aerialists. In most cases, such as mine, I would have already used the prone abdominal drawing-in maneuver as recommended from research in the early-mid 2000s, and am interested in this new DNS method that I just learned. I would write on what I found in the literature, and what happened in the clinic with my aerialist.

Now the exciting part begins! You can use your citations from the last 10 years and submit them with a short blurb on your clinical question, and also submit to the citation blasts that we produce every month. You can use your findings and present them at the next CSM as a poster or platform, and if you are a student, you can apply for the PASIG student scholarship. Before you do that, send me your article and I will help you with edits. I hope this brief tutorial helps, and I look forward to reading your article submission to the PASIG newsletter of the *Orthopaedic Physical Therapy Practice* magazine!

FOOT & ANKLE

FOOT & ANKLE SPECIAL INTEREST GROUP

SPECIAL INTEREST GROUP

President's Note

Clarke Brown, PT, DPT, OCS, ATC
FASIG President, 2010-2016

Christopher Neville, PT, PhD
FASIG President, 2016-2019

The analogy "it's a marathon, not a sprint" refers to the endurance needed to complete 26.2 miles of running and reminds us that some of the tasks we encounter through our careers also require stamina and commitment. Perhaps it is owning a physical therapy business, treating a challenging patient, or advancing our own skills through a process of life-long-learning; the effort requires dedication and sustained pressure over the long course. This reference to a marathon reminds us that the time-course for the FASIG must be viewed as something in the likeness of an ultra-marathon, and more specifically, one that can only be run as a relay. It is this relay that brings us to the current state for FASIG as the term for President ended at the conclusion of the Combined Sections Meeting. We write this "President's Note" together as we pass the baton and welcome the opportunity to refocus and reflect on our path and trajectory. The President from 2010-2016, Clarke Brown, steps away as Christopher Neville steps in to fill the FASIG shoes. Additionally, Judy Gelper, who has served as Chair of the Nominating Committee, also completes her term; thank you Judy!

Perhaps this is a good time to reflect briefly on the success and direction we have gone in the past few years. The FASIG approved the motion to develop entry-level curricular guidelines in 2012, completed the task force development of these guidelines (Foot and Ankle Curricular Guidelines for Physical Therapist Professional Degree Programs), and can now point to their publication and adoption as an educator's resource on the Orthopaedic Section website: http://www.orthopt.org/content/special_interest_groups/foot_ankle as well as APTA's website at http://www.apta.org/Educators/Curriculum/Section

In addition to the work completed on the curricular guidelines, the FASIG also remained committed to supporting ongoing research with two, $15,000 allocations to allow the Orthopaedic Section to fund foot and ankle research. This dedication to advancing an understanding in foot and ankle content is one the FASIG should be proud of, and vow to continue. Finally, we can point to an ever-growing interest group with the current state of the FASIG standing at just over 600 active members.

Now, to the future! We have many great individuals excited to tackle topics such as advanced practice, a national network of individuals and resources related to foot and ankle care, further translation of the curriculum guidelines into classrooms across the country, and further research development, just to name a few. But, as we continue work on these tasks, we want to also make sure we take the time to communicate and solidify our network known as the FASIG.

The FASIG is 600 members strong—this is a group of shared-interest individuals that serve as our single strongest resource—all of us Orthopaedic Section members that together, make us the FASIG! Over the next year, we plan to provide a line of communication to engage the wider FASIG and plan to hold our first "networking night" at CSM 2017. So, if you are interested in foot and ankle care across the continuum (pediatrics to geriatrics, orthopaedics to neurologic) or are interested in being involved with FASIG, watch your email in the coming weeks. If you don't get an email from the FASIG, then contact Tara Fredrickson at the Orthopaedic Section office (tfred@orthopt.org) to make sure you are on our list. The Combined Sections Meeting was a great opportunity, once again, to connect with colleagues, hear new research, explore programing, and invigorate as physical therapists here in the United States. Let's plan to once again make the FASIG a big part of that energy at CSM 2017 and keep an eye out for communication from the FASIG leadership in the coming weeks.

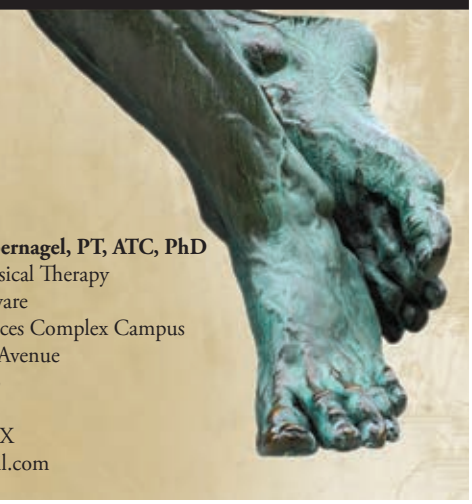
FOOT & ANKLE OFFICERS

President:
Christopher Neville, PT, PhD
Upstate Medical University
750 E. Adams Street
Syracuse, NY 1321
(315) 464-6888
nevillec@upstate.edu
Term: 2016 - 2019

Nominating Committee Chair:
Steve Pettineo, PT, DPT, OCS
Chadds Ford, PA
(215) 625-5378
sjpettineo@comcast.net
Members: Ruth Chimenti, Eric Folmar

Vice President:
Todd Davenport, PT, DPT, MPH, OCS
Dept of Physical Therapy
University of the Pacific
3601 Pacific Ave
Stockton, CA
(209) 946-3159
tdavenport@pacific.edu
Term: 2011 - 2017

Practice Committee:
Clarke Brown, PT, DPT, ATC, OCS
1900 West Wayne Plaza
Macedon, NY 14502
(315) 986-4655
(315) 986-5901 FAX
brownstonept@gmail.com



Research Chair:
Karin Grävare Silbernagel, PT, ATC, PhD
Department of Physical Therapy
University of Delaware
STAR Health Sciences Complex Campus
540 South College Avenue
Newark, DE 19713
(302) 831-4808
(302) 831-4234 FAX
kgsilbernagel@gmail.com

A Model for Clinical Reasoning in Persistent Pain

Sarah Wenger, PT, DPT, OCS[1]
David Banz, SPT[2]
Glenn Terry, SPT[2]

[1]*Assistant Clinical Professor*
[2]*Student, Drexel University, Philadelphia, PA*

Persistent pain is a challenging condition to manage. New knowledge has created changing paradigms in clinical reasoning, but as a whole, the health care system has not fully incorporated these new strategies. The Institute of Medicine (IOM) released a report in 2011 that identifies deficiencies in current practice and calls for increased and improved education of both individuals with chronic pain and health care providers.[1] The report argues that the outcomes of this education should be the expanded use of existing knowledge, improved individualized pain care, and emphasis on self-management techniques. According to the report, chronic pain impacts 100 million Americans with health care costs reaching roughly $635 billion per year.[1] We will be referring to chronic pain as persistent pain throughout this article. "Chronic" connotes permanence while "persistent" acknowledges the ongoing nature of the problem along with the possibility for improvement.

Evidence outlined in the IOM report tells us that patient education, interdisciplinary teams, and psychosocial-informed care are the cornerstones of managing persistent pain. Examples of how to structure these treatments vary in the literature and there are few examples in outpatient settings. Instead of offering an algorithm or specific treatment suggestions, this article offers a structure for clinical reasoning. This approach directs readers to consider the array of variables and evidence related to persistent pain and to use broad thinking to arrive at the best decisions for each individual patient. The model shown in Figure 1 depicts a clinical reasoning framework for persistent pain. This article describes each part of the model starting with the goal of treatment, followed by the model of care, and ending with a description of the evidence available in a wide range of fields pertaining to persistent pain.

The goal of treatment is represented at the top of the model: a self-managing patient who is supported by a team of health care consultants. Chronicity of any kind calls for a self-management model in which the patients treat themselves and health care providers serve as the consultants and educators who help them achieve their goals. The focus shifts from getting the patient better to equipping the patient to manage independently empowering them to navigate their ongoing pain and limitations. As consultants and educators the health care team partners with the empowered patient to design and implement their plan of care. This shift requires us to change how we create and track outcomes, moving away from symptom and impairment-based goals and instead using outcomes that measure knowledge, behavior change, and ability to manage symptoms.

Figure 1. Drexel University Clinical Reasoning Model for Persistent Pain. Reprinted with permission from Drexel University.

Moving down to the middle of the model, we have an interdisciplinary team of health care providers who coordinate the plan of care and goals, which should be global and centered on the patient. If the health care team does not coordinate effectively, the patient is left with disjointed care that can be overwhelming with a complex problem like persistent pain. This model places the onus of coordination on the health care team rather than expecting patients to put all the pieces together themselves. Providers have their own plans and goals specific to their area of expertise, but these must tie in and contribute to the global goals and plan of care for the patient. The literature on persistent pain suggests that treatment in interdisciplinary teams is most effective, but what exactly does that mean? If a patient is seeing a physical therapist, primary care doctor, specialist, and behavioral health all in different offices, does that qualify as an interdisciplinary team? We would argue that it alone, does not. The concept of a team implies communication and coordination, and we believe these team traits are imperative for successful outcomes.

In an outpatient setting, especially in freestanding clinics, coordinating care with an interdisciplinary team can be challenging. Solutions to these challenges depend on many variables and are individualized to each practice, but most practices share some common communication barriers. Privacy laws largely limit the use of new communication technology such as email and text messaging. Phone calls and fax are far less efficient and can delay care or result in missed opportunities to communicate. Time management presents as another barrier; clinicians have little time for phone calls in addition to daily patient care, note writing, and administrative demands.

In clinical settings that do not have integrated interdisciplinary care, physical therapists should consider reaching out to practitioners in their community. Building networks and referral relationships will create mutual understanding that leads to efficient, effective, and cohesive care. When a patient's care is well coordinated and all members of the team have the same goals, visits run smoothly because there will be overlap and reinforcement in education, planning, and treatment. Coordinated care should also lead to better patient outcomes, especially when dealing with complex problems like persistent pain.

The bottom of the model depicts pillars of evidence. Just like the interdisciplinary team, the pillars represent evidence from a wide range of fields. Below we provide an overview of the evidence available in each field that pertains to persistent pain. Obviously, this overview is broad, and we hope to provide readers with enough information to inspire further knowledge acquisition in each area.

NEUROSCIENCE

The field of neuroscience helps us understand how the brain processes and perceives pain and how persistent pain alters the structure and function of the nervous system. Pain is often viewed as a "bottom up" phenomenon that stems from the source of nociceptive input and travels up the dorsal horn pain projection neurons and into the brainstem, thalamus, and cortex where it can be processed as pain. Persistent pain, however, leads to neuroplastic adaptations in the peripheral and central nervous systems that alter the perception of pain.

The process begins with a stimulus that persists for a long period of time. This prolonged stimulation drives the sensory receptors and pain projection neurons in the spinal cord to increase their dendritic arborizations and the size of their axonal fields resulting in peripheral and central hypersensitivity. As this prolonged input progresses towards the third order neurons, the periaqueductal gray in the midbrain undergoes changes that result in the activation of On-cells in the reticular formation. These On-cells stimulate dorsal horn pain projection neurons to send more pain signals to the thalamus, thereby creating a new circuitry that creates pain without the original stimulus. The continued up-regulation of pain input increases stimulation of large areas of the cerebral cortex, limbic lobe, amygdala, and hypothalamus and strengthens pathways that overlay perception of pain with emotion.

Similar neuroplastic changes occur in patients undergoing persistent stress. Studies have shown that patients experiencing persistent emotional stressors have larger amygdalas and smaller hippocampal formations.[2] These findings suggest that persistent stress expands areas of the brain associated with emotion and the fight or flight response while decreasing the size of areas associated with memory, learning, and emotional control. These neuroplastic changes create heightened responses to stress with diminished memory and cognition leading to increased potential for affective and anxiety disorders. Since pain perception is overlaid with emotion through pathways with the amygdala, chronic stress may increase the perception of pain and persistent pain may increase the perception of stress.[2]

In patients with persistent pain, both neuroanatomical and neurophysiological changes occur within the brain. Hence, a 'top down' rehabilitation approach that focuses on cognition, behavior, and perception may be more beneficial than a "bottom up" approach that focuses on musculoskeletal anatomy. Positive neuroplastic changes are possible but may warrant treatment techniques that seem outside the typical scope of orthopedic physical therapy. Motor learning and neurology research have explored strategies for creating neuroplastic change and it is important to incorporate that knowledge into our plan of care for patients with persistent pain.

MENTAL HEALTH

Mental health, as defined by the World Health Organization (WHO), is a "state of well-being in which an individual realizes his or her own potential, has the ability to cope with the normal stressors of life, can work productively and fruitfully, and is able to make contributions to her or his own community."[3] It is important for physical therapists to acknowledge all of these mental health components because patients with persistent pain often present with challenges spanning this definition. Physical therapists should address patients' ability to cope with stressors related to movement and physical function. While our focus is on physical limitations, the reasons for these limitations may have strong psychological ties that we need to address in an informed and skilled manner.

Patients experiencing persistent pain can lose an accurate sense of their functional potential after developing fear of moving or performing specific tasks. Catastrophizing about the effects of performing those activities further limits patients from realizing their potential. This fear and catastrophizing mentality causes patients to avoid activity, which can lead to a downward spiral of weakness, weight gain, poor fitness, and further pain and inactivity. This is not a new concept for any experienced clinician, but working to improve cognition and emotions related to movement is not typically an overt target of our plan of care. It is important to create an environment that empowers patients to break the cycle. To create this type of environment, we teach patients how to solve problems and preserve their energy. We partner with patients to learn how to best handle their physical and emotional stressors. The goal of addressing mental health in physical therapy is to promote resilience, coping strategies, and a sense of control around issues related to movement. While we are not mental health specialists, we are movement specialists, and we must address the mental health issues that precipitate and result from movement dysfunction.

PUBLIC HEALTH

Some of the most compelling public health research has focused on Adverse Childhood Experiences (ACEs).[4] In 1998, one groundbreaking study surveyed more than 17,000 adults living near San Diego about their current health and adversities experienced before the age of 18. Results showed that approximately two-thirds of the population had experienced at least one type of child abuse, neglect, or family dysfunction and that 12.5% had experienced 4 or more adverse childhood experiences. The study showed a dose-dependent relationship between ACE score and a wide range of social, physical, and mental health problems, including persistent pain. Adverse Childhood Experiences and other forms of chronic stress change the physiology of the brain, altering emotional control and cognitive function. It is possible then, that ACEs and other forms of chronic stress predispose patients to higher fear avoidance behaviors and catastrophizing beliefs, both known risk factors for persistent pain.[4,5] As clinicians, we should appreciate that remote events in a patient's history could have a powerful influence on his or her current health and health behaviors. Obviously there is nothing we can do to change past experiences, but we can understand how they impact our patients' current behaviors. This understanding should lead us away from thoughts like "I can't help them if they won't help themselves" and "they just don't want to get better" and towards more empathic and informed beliefs. This shift in thinking creates a shift in care that leads to better outcomes. Instead of becoming frustrated by counterproductive behaviors, we can step into our role as educators and mentors. We can make

patients aware of behaviors we feel worsen their pain, teach them how changing those behaviors will help, and mentor them as they negotiate their individual barriers to behavior change.

EDUCATION

Patient education is one of the best interventions available to physical therapists treating patients with persistent pain.[6] According to Bloom's Taxonomy, the act of learning is based on knowledge of facts, concepts, principles, and theories.[7] It then progresses towards the highest level of learning, which is evaluating and synthesizing information and ideas. If physical therapists apply this model to persistent pain, then education starts by teaching fundamental concepts: the neuroscience of pain, pacing, ergonomics, body mechanics, posture, etc. Education should then progress to higher levels so that patients learn to evaluate and synthesize their new knowledge of pain and motion with their previous knowledge of physical and emotional stressors and other contextual factors.

We also recognize that each discipline offers important educational components, and we must help patients achieve a cohesive understanding of how our teaching integrates within the greater knowledge base. When patients synthesize new learning from each discipline, they can achieve an improved, more nuanced, and realistic understanding of their current condition, their path to recovery, and their hopes and goals. We must be clear that while education is the treatment, changes in beliefs and behaviors are the outcomes. An example of change in behavior is the patient who vacuums half the living room instead of the whole room to avoid a flare-up of pain. An example of change in beliefs might be improvement in fear avoidance or catastrophizing measures.

We can also look to the education literature for teaching tools.[8] If we are focused on advanced learning, then we must use the appropriate instructional methods to meet our goals. Instruction should be tailored to the individual patient's needs, beliefs, prior knowledge, and learning styles. Patients all present with different histories and beliefs and our approach to education should vary based on the individual patient learner. For adult learning, we recommend a mentorship model in which clinicians partner alongside patients to teach them how to integrate ideas and create individualized solutions. By partnering with patients, we give them ownership of their educational journey, and it is this ownership that achieves our goal of self-management.[9]

There are many potential barriers to effective education in health care, both on the side of the patient and the provider. Patient barriers might include chronic stress, intellectual disabilities, mental health decline, fear, or mistrust. Provider barriers might include poor patient engagement, inadequate teaching skills, belief that education will be ineffective, and poor time management. Creating an educational plan of care should be a collaborative process based on sound educational principles, individualized instructional strategies, and barrier assessment.

WELLNESS

Maintaining an optimal level of wellness is crucial to living a higher quality life. Everything we do and every emotion we feel relates to our well-being that directly affects our behavior, beliefs, emotions, and health. According to the WHO, wellness is "a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity."[10] The complexities that span social, physical, and mental health make wellness elusive for many patients with persistent pain. Wellness must become a conscious, self-directed process of achieving full potential. Patient barriers and complex cases can make achieving wellness a daunting task. A complete review of wellness tools is outside the scope of this article, but mindfulness, meditation, yoga, and many other techniques have been shown to help patients with persistent pain.[11,12] As physical therapists, we should take the lead in efforts to improve general fitness. Global strengthening, cardiovascular health, weight loss, balance, alignment, and activity pacing are all areas to focus our treatment. Since persistent pain is largely mediated by central mechanisms, a global approach for general fitness is often as important as focused treatment of the original peripheral pain source.

CLINICAL KNOWLEDGE

A plan of care that considers knowledge of the anatomy, diagnosis, and literature pertaining to the original peripheral source of pain is of course important. However, it is equally important to treat the neurological origins of persistent pain by using interventions to create positive neuroplastic changes. Intervention strategies to promote these changes include repetition, feedback techniques, and formulating the optimal practice schedule for each patient. For example, intensive feedback that focuses on movement sequence has been found to create lasting improvements in movement patterns and behaviors.[13] It is important to couple our clinical knowledge of orthopedics, motor learning, neurology, and other clinical areas to create best practice, treatment, and plans.[14]

PATIENT CHARACTERISTICS

Clinical decisions may be largely based on a patient's specific characteristics, circumstances, and preferences. It is important that clinicians do not make assumptions about patients, but instead engage them in the decision making and reasoning process. If patients understand the provider's thinking, they are better able to share pertinent thoughts and opinions. The physical therapist provides health care expertise, but the patient is the expert on his/herself and is frequently best poised to decide what plan of care will be most successful. People and the contexts in which they live are complex. No matter how much we learn about and get to know our patients, we will never capture every nuance. This is why engaging the patient in care decisions and the reasoning behind them is essential. When patients and clinicians communicate effectively, they synthesize the information together and create solutions to improve that patient's quality of life.

CONCLUSION

We hope this clinical reasoning model helps readers conceptualize persistent pain holistically and provides the tools to be flexible, creative, resourceful, and confident when working with this patient population. Key clinical points are summarized below:

- Engage and Empower Patient
  - Determine patient goals
  - Focus on education
  - Identify barriers
  - General exercise

- Promote wellness
- Communicate with Interdisciplinary Team
- Base Decisions on a Wide Array of Evidence

Neuroplastic and psychosocial factors can make treatment focused on local pain and limitations less successful, but offer new targets for treatment. These treatment approaches can create compelling therapeutic gains even in the absence of substantial improvement in pain or limitations. Persistent pain is a complex condition requiring a team approach that empowers patients to take ownership of their treatment. It is important for physical therapists to understand their role in this complex puzzle of interdisciplinary care and to take the lead on coordinating that care for the well-being of each individual patient.

Our interdisciplinary team created educational patient handouts that are available to clinicians and patients at: http://bit.ly/poweroverpain.

REFERENCES

1. IOM Report: Relieving Pain in America: A blueprint for Transforming Prevention, Care, Education and Research. Washington, DC: The National Academies Press, 2011.
2. Boyle LM. A Neuroplasticity Hypothesis of Chronic Stress in the Basolateral Amygdala. *Yale J Biol Med*. 2013;86(2):117-125.
3. Mental Health: a state of well-being. World Health Organization. http://www.who.int/features/factfiles/mental_health/en/. Updated August 2014. Accessed February 16, 2016.
4. Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, Koss MP, et al. The relationship of adult health status to childhood abuse and household dysfunction to many of the leading causes of death in adults: the adverse childhood experiences (ACE) study. *Am J Prev Med*. 1998;14:245-258.
5. Waite, R., Davey, M., & Lynch, L. Self-rated health and association with ACEs. *J Behav Health*. 2013;3(3):197-205. doi:10.5455/jbh.20130317033246.
6. Moseley GL, Nicholas MK, Hodges PW. A randomized controlled trial of intensive neurophysiology education in chronic low back pain. *Clin J Pain*. 2004;20(5):324-30.
7. Bloom BS, Krathwohl DR. *Taxonomy of Educational Objectives: The Classification of Educational Goals, by a Committee of College and University Examiners. Handbook 1: Cognitive Domain*. New York, NY David McKay; 1956.
8. Plack M, Driscoll M. *Teaching and Learning in Physical Therapy: From Classroom to Clinic*. Thorofare, NJ: Slack Inc. 2011.
9. Knowles M. *The Modern Practice of Adult Education: From Pedagogy to Andragogy*. New York, NY: Cambridge of The Adult Education Company; 1980:44-59.
10. Constitution of the World Health Organization. World Health Organization: Basic Documents, 45 ed. http://www.who.int/governance/eb/who_constitution_en.pdf. Updated October, 2006. Accessed February 15, 2016.
11. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29(5):450-60. doi: 10.1097/AJP.0b013e31825e1492.
12. Han A, Robinson V, Judd M, Taiziang W, Wells G, Tugwell P. Tai chi for treating rheumatoid arthritis. *Cochrane Database Syst Rev*. 2004;(3):CD004849.
13. Schon-Ohlsson C, Willen J, Johnels B. Sensory motor learning in patients with chronic low back pain: a prospective pilot study using optoelectronic movement analysis. *Spine*. September 2005:30(17): E509-16.
14. Gatchel RJ, Bo Peng Y, Peters ML, Fuchs PN, Turk DC. The biopsychosocial approach to chronic pain: scientific advances and future directions. *Psychol Bull*. 2007;133(4):581-524.

IMAGING

SPECIAL INTEREST GROUP

President's Message

Charles Hazle, PT, PhD

The Imaging Special Interest Group is readying for major activity. Under Doug White's guidance as President since being established as a SIG, we have grown considerably with over 230 members currently. The day prior to the start of Combined Sections Meeting, the outgoing officers, incoming officers, and several other prominent members of the SIG met to formulate a rather ambitious plan in support of imaging being an integral part of physical therapist education, practice, and research. Details of the SIG's goals and objectives will be coming soon and we will be soliciting involvement from many of you to help drive this effort.

Last year, we published the Imaging Education Manual. This year we have in the works a position paper regarding imaging in physical therapist practice. Similarly, we will also be active at NEXT in Nashville in June to help establish a course of action within APTA toward imaging in clinical practice.

In the next edition of *OPTP*, we will lay out our plans in greater detail.

Call for Imaging Submission

The Imaging SIG is soliciting submissions for publication in the imaging column of *OPTP.* Types of submissions can include:

- **Case Report:** A detailed description of the management of a unique, interesting, or teaching patient case involving imaging. Case reports should include Background, Case Description including Imaging, Outcomes, and Discussion.
- **Resident's Case Problem:** A report on the progress and logic associated with the use of imaging in differential diagnosis and/or patient management. Resident's Case Problem should include Background section, Diagnosis section which details the examination and evaluation process leading to the diagnosis and the rationale for that diagnosis, including a presentation of imaging studies. The Interventions section used to treat the patient's condition and the outcome of treatment; however, the focus of the resident's case problem should be on the use of Imaging in the diagnostic process and patient management. The Discussion section offers a critical analysis of how the Imaging guided the management of the patient.
- **Clinical Pearl:** Clinical pearls are short papers of free standing, clinically relevant information based on experience or observation. They are helpful in dealing with clinical problems for which controlled data do not exist. Clinical Pearls should describe information pertaining to Imaging that help inform clinical practice.

Submissions should be sent to:
Joel Fallano, jfallanopt@verizon.net

CLINICAL PERSPECTIVE

Chronic Osteomyelitis following Anterior Cruciate Ligament Revision Reconstruction using Patellar Allograft

Justin M. Lantz, DPT, OCS, FAAOMPT[1]
Alicia Emerson-Kavchak, DPT, OCS, FAAOMPT[1]
Ejaz Shamim, MD[2]

[1]*Physical Therapist*
[2]*Attending Radiologist, University of Illinois Hospital, Chicago, IL*

The patient is a 43-year-old male who had previously undergone left anterior cruciate ligament (ACL) reconstruction with bone-patellar tendon-bone allograft. He suffered a fall 18 months postoperatively and elected to have a revision of the graft secondary to subsequent knee instability. Post-revision, a complete physical therapy (PT) evaluation by the primary author revealed no adverse sequelae and the patient completed treatment at an outside clinic. Unexpectedly, he was diagnosed with a methicillin-sensitive staphylococcus aureus (MSSA) infection in the tibial post and underwent irrigation and debridement along with antibiotic treatment. After proper management of the infection, the patient was under care at the primary author's clinic for his remaining PT treatment. Physical rehabilitation progressed well, however, he "twisted" his knee while shoveling snow and subsequently presented to the clinic with increased pain and moderate knee edema. An examination revealed intact ligamentous testing, however, he had pain independent of activity and erythema around the tibial portal, edema, and warmth.[1] Although recurrent infection and osteomyelitis are extremely rare after ACL reconstruction,[2] these findings combined with his patient history warranted referral to orthopaedics for further evaluation and imaging. Routine radiographs were unremarkable; however, multiplanar multisequence magnetic resonance imaging identified extensive bone marrow edema and enhancement in the tibial tunnel and increased signal intensity of the ACL allograft (Figures 1, 2, and 3). These findings raised concerns for chronic osteomyelitis. Consideration is often given to graft removal after persistent infection[3] and the patient subsequently underwent arthroscopic removal of all hardware and graft with full resolution of symptoms. The patient resumed PT and achieved full return to running, cutting, and jumping allowing for unrestricted participation in recreational and family activities.

REFERENCES

1. Gardner SE, Frantz RA, Doebbeling BN. The validity of the clinical signs and symptoms used to identify localized chronic wound infection. *Wound Repair Regen.* 2001;9(3):178-186.

Figure 1. T1 weighted fat saturated post contrast image in sagittal view with enhancement of edema around tibial tunnel (yellow arrow).

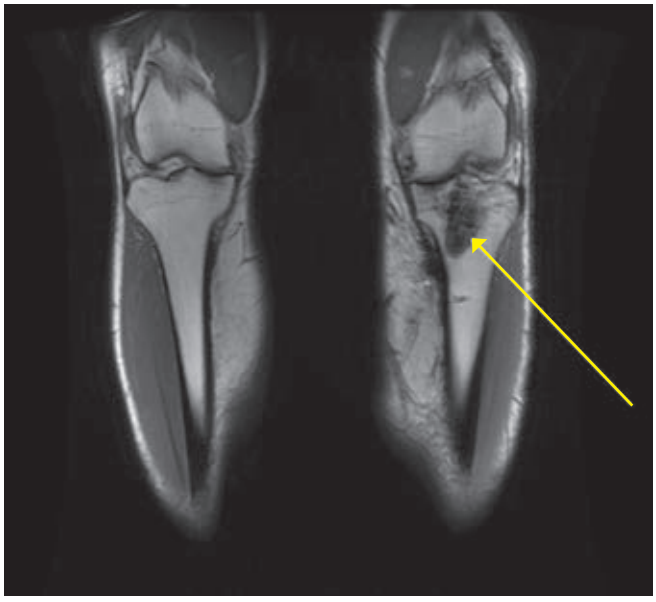


Figure 2. T1 weighted image in coronal view with low intensity bone marrow at anterior cruciate ligament graft site (yellow arrow).

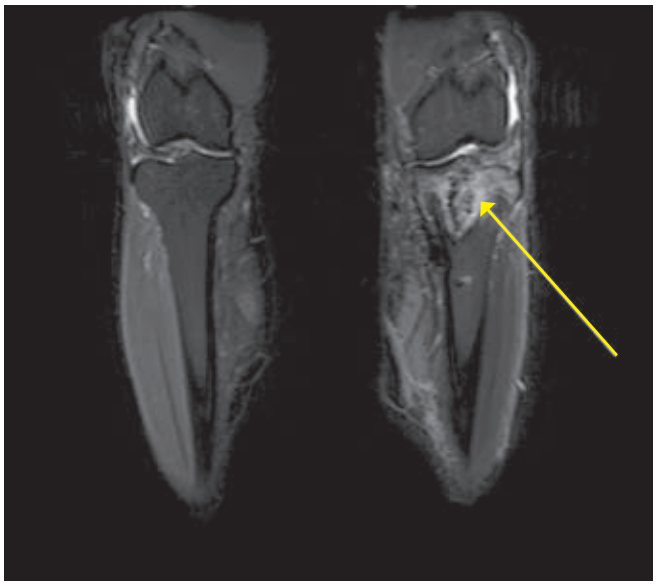


Figure 3. Fluid sensitive short TI inversion recovery (STIR) sequenced image in coronal view with high signal edema surrounding tibial tunnel (yellow arrow).

2. O'Neill BJ, Molloy AP, McCarthy T. Osteomyelitis of the tibia following anterior cruciate ligament reconstruction. *Int J Surg Case Rep*. 2013;4(2):143-145. doi: 10.1016/j.ijscr.2012.10.020; 10.1016/j.ijscr.2012.10.020. Epub 2012 Nov 29.
3. Stucken C, Garras DN, Shaner JL, Cohen SB. Infections in anterior cruciate ligament reconstruction. *Sports Health*. 2013;5(6):553-557. doi: 10.1177/1941738113489099.

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT

APTA Combined Section

The ARSIG was proud to host an outstanding educational session during the 2016 APTA Combined Sections Meeting in Anaheim, CA. The two-hour programming highlighted the sport of Olympic equestrian show jumping and was presented by Sharon Classen, PT, and Mark Revenaugh, DVM. The speakers combined their expertise in giving a remarkable talk on common injuries associated with the sport including observations on biomechanical faults of both rider and horse. An exceptional highlight of the presentation was the use of multiple interactive videos displaying the skill of elite competitive equestrians from prior Olympic competitions. The integration of clinical reasoning during case study analysis from the perspective of both veterinarian and physical therapist was also well worth the price of admission, even without the luxury of hot buttered popcorn.

Notice Anything Different Lately?

I urge you to log on to the ARSIG's website and ask one simple question, *"Hum, does anything look new on the site today?"* Did you miss it…then look again. Yes, it is true, the SIG has finally adopted an official logo and as a bonus it includes color! The SIG officers finally concluded that there are only so many ways to depict a horse, a dog, and a cat without violating good humor laws, so a decision was made to call in the experts. A professional graphic artist was consulted to design a logo that can be used for years to come, and without causing undue stress to anyone who might be offended by amateur alternatives.

Practice Analysis Update

The Practice Analysis survey has now advanced to pilot-study review. A select group of physical therapists in animal rehabilitation will review the survey and provide final suggestions and edits before surveying the entire ARSIG membership. Conducting a practice analysis is a vital "next step" in the process of legitimizing the option for physical therapists to treat animals on a professional level. The goal is to disseminate a description of practice to educate the public at large on what competencies physical therapists exhibit when treating animals beyond the act of just loving them as companion pets like millions of others. Point being, it is time to get serious about the practice of animal rehab, and the only way to move the profession forward in a positive way is to define the competencies physical therapists possess through valid research methods.

California Veterinary Medical Board

You must think I love California for all the type-space dedicated to the state over the past couple of years. However, it is a state in constant need of attention by the physical therapy profession. Karen Atlas has been outstanding in keeping the SIG informed as to what is happening in California, so I thank her again for remaining vigilant to the constant change in action by the Vet Medical Board (VMB). It remains a mystery as to exactly what the next steps will entail to address concerns by the VMB, but it is quite possible that legislative involvement will be part of the picture. Regardless of where things lead next there is one absolute, physical therapists involved in animal rehab in California need to absolutely be engaged in the process. To be engaged means to lend a voice during public hearings, to write letters in support of physical therapists treating animals, and to attend public VMB meetings when possible.

Evidence in Action

In this edition of *OPTP,* I would like to openly express my gratitude to both Stuart Bliss, DVM, and Charlie Evans, PT, for sharing their wisdom on the topic of iliopsoas conditions common to the canine client. Charlie graciously accepted a personal invitation to submit an educational piece in support of the ARSIG's mission to disseminate evidence to enhance knowledge on a more global perspective. So thank you Charlie and Stuart; you are great representatives to the practice of animal rehabilitation.

Time to Share Your Story

I offer to all ARSIG members a "golden" opportunity to once again submit ideas or concepts you wish to see addressed in future editions of *OPTP*. The ARSIG is always open to fresh insights on member interests, but I cannot read minds. So please do not hesitate to articulate your aspirations. Send an email or give me a call to share your thoughts on how to continually improve the value of being an ARSIG member.

Engagement is for Everyone

I am going to finish this edition of the President's Message with a bit of philosophical rambling, but rambling on something of vital importance. The topic is the act of engagement and why, now more than ever, physical therapists who treat animals absolutely need to get actively engaged, and there are many avenues to make this happen. Let me share a few options where the physical therapist voice needs to be heard loud and clear.

1) State legislative and regulatory arenas – Fact is the majority of states do not have codified language supporting physical therapists to legally treat animals. This needs to change, and waiting for a complaint against a personal license is too late. So please review your state practice laws, including language in the veterinary scope of practice to see if physical therapists are allowed in some fashion to legally practice on animals. If language is void, then assuming PTs can simply cross over from humans to treat animals under the auspice as a physical therapist is taking a significant liability risk.
2) ARSIG involvement – There are several ways to support the ARSIG, and although I have outlined many options in the past, I will repeat one again; it is article submissions. In all honesty it would be wonderful if I had a backlog of articles to review for publication in

OPTP, but unfortunately I do not. The idea of submitting articles is to share knowledge with your colleagues to advance the practice of animal rehab. In other words, it defines the essence of being collegial and supports the overall advancement of animal practice.

3) Run for an elected office – In the next year, the ARSIG will be seeking nominations for the position of Vice President. This will be an excellent leadership opportunity for anyone interested in getting directly involved in the ARSIG and the Orthopaedic Section as well.

Pocket Philosophy

Physical therapy is a unique and specialized profession dedicated to restoring normal movement and function. Since codified laws do not restrict movement as pertaining to only humans, the expertise of physical therapists can subsequently benefit all breathing creations if provided a grain of ingenuity. As some practitioners in the profession migrate toward animal care, the evidence is clear that the skills and competencies defining physical therapy are more than transferable. In fact, based on personal experience working with both canine and equine clients, I can state without hesitation that outcomes resulting from physical therapy involvement to improve the quality of life in animals is truly remarkable. What I hope history records in due time is that physical therapists will have become mainstay providers of animal rehabilitation and integral facilitators of enhancing sport performance in a variety of settings across the country. Dreaming? Of course I am, but what is life for, if not to plant a vision of what could be.

A Salute To Our Most Valued 2- & 4-Legged Heroes!

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

Repetitive Strain Injury of the Psoas Muscle in Dogs

Stuart Bliss, DVM, PhD, DACVS, CCRP
Charles Evans, MPT, CCRP

Repetitive overuse of the psoas is a common yet underappreciated cause of mobility impairment in the dog. Sustained contraction, fatigue, and spasm of the psoas musculature develop frequently in dogs with a wide range of orthopaedic or neurologic disorders as they alter their posture to compensate for painful or dysfunctional limbs. This form of repetitive strain injury (RSI) can be difficult to recognize, yet it is a significant cause of pain and decreased mobility, especially in geriatric dogs. Strain-counterstrain is a manual therapeutic technique adapted from the field of physical therapy that can be used to treat psoas muscle strain that develops secondary to injury or surgery. It is also a useful method for preservation and enhancement of mobility in older dogs suffering from chronic progressive degenerative joint disease. This article presents an overview of the pathomechanics, diagnosis, and management of psoas RSI in dogs.

PATHOMECHANICS

The musculoskeletal system is highly interconnected and functionally integrated, and injuries or disorders affecting any one part of this system often lead to secondary problems and malfunction at other sites. For example, the limp that develops in humans following even a mild ankle sprain can lead to flares of secondary lower back pain due to changes in posture and body mechanics at the level of the hip and spine. Physical therapists have long recognized the deleterious changes in posture and movement that develop in humans in response to specific injuries or orthopaedic disorders, and a major goal of physical therapy is to limit this "ripple effect" of secondary pain and dysfunction. Dogs also adopt compensatory postures and patterns of movement in response to injury or orthopaedic disease, and these changes in basic body mechanics can also lead to problems at distant sites. One of the most common examples of this is psoas RSI that develops in association with pain and dysfunction of a hind limb.

Hind limb lameness is the most common form of mobility impairment in the dog. Disuse or offloading of a hind limb results in several characteristic postural changes including low and extended head carriage, elbow abduction, sloping of the topline with elevation of the pelvis above the level of the scapulae, and hunching or "roaching" of the lumbar vertebral column into an abnormally kyphotic conformation (Figure 1). These adaptive changes are designed to shift a dog's center of gravity towards the forequarters and offload the hind limbs. Lumbar roaching is a consistent postural adaptation to hind limb lameness; the psoas musculature is one of the primary structures responsible for maintaining the lumbar spine in a roached position.

The psoas system consists of several muscles that originate along the ventral aspect of the cranial lumbar vertebrae and that insert on the pelvis and proximal femur. The major component of the psoas system is the iliopsoas, which inserts on the lesser trochanter of the femur. The iliopsoas is an important flexor of the hip. The psoas system as a whole also functions to flex the lower spine and draw the pelvis forward under the body. Such lumbar flexion occurs normally during certain gaits such as the gallop. However, in response to hind limb lameness, the psoas musculature is recruited into a postural role and undergoes sustained contraction to maintain lumbar flexion.

DIAGNOSIS

Two forms of psoas muscle injury are recognized in dogs. The classic form is a sprain of the iliopsoas at its musculotendinous junction. This is usually a painful, traumatic injury. Iliopsoas sprain is common in sporting dogs and is often associated with high-intensity activities that subject the hip to forceful extension, such as hard running or certain agility exercises. In con-

Figure 1. This dog shows classic hind limb off-loading posture. Note the elevated pelvis, low head position, and lumbar roaching (increased lumbar flexion).

Figure 2. Strain-counterstrain maneuver, a manual therapy technique for treatment of psoas strain injury being performed on a dog.

trast, RSI is a more insidious form of injury that is uniquely associated with postural adaptations to hind limb lameness.

Repetitive strain injury refers to a syndrome of muscular pain, spasm, and diminished strength that occur as a result of repetitive activity or constant sustained contraction. In dogs with painful hind limb disorders, persistent forward weight shifting imposes a high workload upon the psoas musculature, and leads ultimately to muscle fatigue and RSI. The psoas muscle is predominantly a fast-twitch muscle, and as such is adapted to cycles of transient forceful contraction and rapid relaxation. As forward weight-shifting posture becomes a chronic condition, the fiber type distribution within the psoas musculature will transition from primarily fast-twitch muscle fibers to a combination of slow- and fast-twitch fibers (adaptive fiber type switching). However, despite this adaptation, the ability of the psoas to function as a postural muscle remains limited.

Psoas RSI is often a clinically subtle condition and may manifest as stiffness after rest, difficulty rising, reluctance to climb stairs or jump into a vehicle, and general exercise intolerance. Some dogs with this condition exhibit pain on deep palpation of the musculature of the groin; however, more commonly, pain is localized to the mid-body as well as the origins of these muscles on the transverse processes of the third and fourth lumbar vertebrae. This form of strain injury does not cause structural abnormalities within the muscle. Thus, radiography, computed tomography, and magnetic resonance imaging of affected muscles are invariably normal. Diagnosis of this condition is based on physical examination and identification of regions of tight and painful muscle (trigger points) within the psoas system.

Psoas RSI can be difficult to recognize and the pain and dysfunction associated with this condition are often attributed to the primary cause of a given hind limb lameness. For example, psoas RSI is extremely common in dogs with hip dysplasia. Hallmark clinical features of hip dysplasia include stiffness and pain on extension of the hip joint. However, this movement also stretches the psoas musculature; thus, resistance to hip extension may reflect pain both at the level of the hip and the muscles of the lower back. Recognition of these interconnected problems is important since the most effective treatment strategies are those that address both conditions simultaneously.

MANAGEMENT OF PSOAS REPETITIVE STRAIN INJURY

Standard approaches to the treatment of psoas RSI have not been established. In all cases, the primary cause of a given hind limb lameness should be addressed if possible. However, this is often difficult in older dogs, especially those suffering from progressive osteoarthritis of key joints such as the hip, stifle, or tarsus. In such cases, treatment of psoas RSI can nevertheless be of value in enhancing the ability of a dog to compensate for ongoing joint degeneration.

Strain-counterstrain is commonly used manual technique used by physical therapists for treatment of a wide range of human muscle strain injuries. It is an emerging approach to the treatment of psoas RSI in the dog. Muscles affected with RSI become hyper-responsive to elongation and when stretched, undergo vigorous and painful reflexive spasm. Strain-counterstrain involves manipulation of a portion of the body into a position that maximally shortens a strained muscle. This position is held for a brief period before the body is allowed to gently return to a neutral position, and the process is repeated several times. Cyclic passive shortening of a strained muscle resets the level of tension in the muscle through modulation of the afferent signaling of the muscle spindle apparatus to the central nervous system. With time, this recalibration of tonic muscle tension and responsiveness to stretch stimuli facilitates gradual relaxation, relief of spasm, and improved stretch tolerance. The basic strain-counterstrain maneuver used for treatment of psoas RSI involves flexion and gentle outward rotation of the hip while a dog is relaxed and lying on its side (Figure 2). This technique is simple to perform, and when incorporated into an individualized home program of daily exercise, can result in meaningful improvements in comfort level and mobility in an affected dog over time.

Our understanding of whole-body adaptations to specific orthopaedic ailments in the dog, and how these can lead to sec-

ondary syndromes of muscular pain and dysfunction is expanding. Many secondary problems respond well to simple and noninvasive manual treatments. Carefully designed programs of exercise and manual therapy can easily be incorporated into home programs, and can be extremely useful tools for long-term preservation of mobility and quality of life in our canine patients.

RECOMMENDED READINGS

- Cabon Q, Bolliger C. Iliopsoas muscle injury in dogs. *Compendium: Continuing Education for Veterinarians;* 2013 (Revised January 2014). https://s3.amazonaws.com/assets.prod.vetlearn.com/5a/6bd040bd7311e28e71005056ad4736/file/PV2013_Bolliger_CE.pdf. Accessed March 1, 2016.
- Canapp S. Non-responsive hind-limb lameness in agility dogs: iliopsoas strains. *Clean Run*. March 2007. http://www.akcchf.org/assets/files/canine-athlete/Iliopsoas-Tendinopathy-groin-pull.pdf. Accessed March 1, 2016.
- Greenman P. *Principles of Manual Medicine*. 4th ed. Baltimore, MD: Lippincott Williams; 2010.
- McGowan C, Goff L, Stubbs N. *Animal Physiotherapy: Assessment, Treatment and Rehabilitation of Animals*. Hoboken, NJ: Wiley-Blackwell Publishing; 2007.
- Millis D, Levine D. *Canine Rehabilitation and Physical Therapy*. 2nd ed. St. Louis, MO: Elsevier-Saunders; 2014.

Alternative Special Topics:

Innovations in Practice

An Independent Study Course Designed for Individual Continuing Education

Independent Study Course 25.3

Course Description

This unique series of monographs contains updated and timely topics on areas of practice influenced by changes in health care and new technologies. The topics will assist clinicians in staying up-to-date to meet the ever-changing demands of practice. Topics include management of shoulder instability, update on treatment of ACL injuries, patellofemoral pain, osteoporosis, management strategies for the obese patient, and musculoskeletal ultrasound.

Topics and Authors

- **The Unstable Shoulder** Brittany Lynch, PT, DPT; Tara Ridge, MS, PT, SCS; Dharmesh Vyas, MD, PhD
- **Advances in Anterior Cruciate Ligament Surgery & Rehabilitation** Kristi Campanella, PT, DPT, OCS, MEd, CPI
- **Patellofemoral Pain & Rehabilitation** Cory Manton, PT, DPT, OCS, CSCS
- **Evaluation and Treatment of the Patient with Osteoporosis** Cynthia Watson, PT, DPT
- **Orthopaedic Management of the Obese Patient** Christopher Lavallee, PT, DPT
- **Musculoskeletal Ultrasound: Its Use in Evaluation and Treatment** Amber Donaldson, DPT, M Physio (Manip), SCS, CSCS; Dustin Nabhan, DC, DAC, BSP, CSCS

3-bundle set includes the following 3 topics: The Unstable Shoulder, Advances in ACL Ligament Surgery & Rehabilitation, and Patellofemoral Pain & Rehabilitation. **6-bundle set** includes all of the bulleted topics listed above.

Continuing Education Credit

Fifteen contact hours for the 3-bundle set and **30 contact hours** for the 6-bundle set 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.

Editorial Staff

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

Learning Objectives

Upon completion of this course, the participant will be able to do the following:

3-monograph bundle

- Define glenohumeral instability and laxity and describe incidence, prevalence, pathomechanics, and mechanism of injury for each.
- Describe the active and passive restraints about the shoulder and describe classification systems for shoulder instability.
- Determine the role of diagnostic testing.
- Determine and perform an examination using appropriate tests and measures to accurately assess shoulder instability and the associated impairments and functional limitations.
- Identify patients most appropriate for nonoperative management of shoulder instability and implement an evidence-based rehabilitation program.
- Understand anatomy and biomechanics of the anterior cruciate ligament and common mechanisms of injury.
- Describe the evidence governing clinical and imaging tests for diagnosing anterior cruciate ligament tears.
- Understand current surgical procedures for various populations and how they impact rehabilitation and recovery.
- Understand the rationale for anterior cruciate ligament prevention programs.
- Identify predictors of anterior cruciate ligament tears and proper testing for risk assessment as supported by research.
- Discuss the biomechanics and pathomechanics of the patellofemoral region and identify movement patterns that may contribute to patellofemoral pain.
- Discuss physical therapy classification of patients with patellofemoral pain.
- Provide evidence-based review of functional tests for the lower extremity.
- Identify and discuss tests and measures that can be used in the identification of pain generators of the patellofemoral region.
- Review current surgical interventions for treatment of patellofemoral pain.

6-monograph bundle

Includes the learning objectives listed above and the following:

- List the risk factors associated with osteoporosis and how such risks are measured.
- Recognize the most common risk factors associated with falls in the elderly.
- Identify self-report measures and clinical tests used to ascertain fall risk and strength.
- Discuss strategies that may be used to reduce fall risk in this population.
- Prescribe and adjust an appropriate exercise program for the patient with osteoporosis.
- Discuss the etiology and prevalence of obesity and list disease risks associated with increasing body mass index as supported by research.
- Identify the genetic, cultural, educational, and age-related characteristics that influence the plan of care for the patient with obesity.
- Review evidence related to the association between increasing weight and painful conditions (ie, low back pain, osteoarthritis) and how they decrease quality of life.
- Explain the evidence-based modifications that should be made when treating patients who are obese.
- Understand the imaging principles of musculoskeletal ultrasound.
- Be familiar with basic scanning methods and normal sonographic anatomy.
- Understand the clinical indications for musculoskeletal and therapeutic ultrasound interventions in orthopaedic physical therapy.
- Be familiar with the appearance of select pathologies using ultrasound.
- Be familiar with invasive and noninvasive ultrasound-guided therapies.

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

Index to Advertisers

Orthopaedic Physical Therapy Practice
Orthopaedic Section, APTA, Inc.
2920 East Avenue South, Suite 200
La Crosse, WI 54601