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ORTHOPAEDIC Physical Therapy Practice

THE MAGAZINE OF THE ORTHOPAEDIC SECTION, APTA

ORTHOPAEDIC Physical Therapy Practice

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

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Editor's Note

From "Head-to-Hands" and Back Again

Christopher Hughes, PT, PhD, OCS

The process of how we apply our craft and what makes a skilled physical therapist is intriguing to me. My sense of tradition tells me that learning has to be taught conceptually and then one needs to practice the skill, allowing the decision's underlying treatment to be put into action. However, at times I wonder if this relationship doesn't flip when one becomes more seasoned…maybe gaining more from doing rather than knowing. Struggling with error then finding the solution versus being taught and then assessed on the instructor's conventional "do as I say" approach. I admit that I am unqualified to delve into the debate on the pros and cons of the numerous learning theories that continually develop. I admittedly left off awhile back somewhere between the big debate on using a problem-based learning approach in physical therapy education. However, I do know and have observed a major difference in how traditional students and adult, or seasoned, clinicians learn. I am sure I am not the only one who has found out that the older you get the harder it is to sit and just read without some intent or ready desire to get to the bottom line. In practice, clinicians get so used to performing in a fast-paced clinical environment that I think it is just hard to downshift and sit still long enough to focus on an article! A common phrase used to be "you are the smartest you will ever be when you graduate." An intriguing statement whereby you know more but ironically, without experience, the ability to translate all that new found knowledge to effective and efficient treatment is usually lacking. The nice to know versus need to know adage seems valid to get the job done in physical therapy. Even though educational curriculums expanded in credits with the DPT, I often wonder if the curriculums try to do too much and we have gotten away from the vocational approach that allows you to "hit the ground running." That seems to be the preference of employers these days, as health care delivery and patient preferences really have no tolerance for a breaking in period. The flip side of this coin is that patients also need to raise the bar and be active participants in their own rehabilitation due to limited visits and changes in referral patterns. The fact remains that when both physical therapists and patients are vested, everyone wins. When neither occurs, the loss costs time and money. Enter the art and science of physical therapy.

The blending of these two facets is what led to the birth of the Section's own Annual Meeting 3 years ago. The Section leadership wanted a more intimate learning environment. Not to supersede CSM, but to compliment the "big house" feel of CSM with a small venue format that would allow more lab time. A more cohesive tie-in between didactic and hands-on gets to the heart of what we need to do on a day-to-day basis. The change in venue is like going from a big rock concert stadium to a small theatre stage in order to bring out the acoustics and connect better with the audience.

This year's event took place in Phoenix with another great showing of attendees and a noticeable increase in vendor participation. I think the days of just passively being seated in the audience at a conference are pretty much ineffective with regard to learning and time. And our feedback shows this. Since its inception in 2012, the responses from registrants have been very positive with attendees favoring the "listen-then-do" format of the keynote address to the general session lecture and then the small, lab-based breakout sessions that are preselected by attendees. This format hopefully gets to the heart of practice. The vocation of a physical therapist is based not solely on knowledge, but the application of that knowledge in caring for the consumer.

Bottom line is, we are judged not by the degrees we have hanging on our walls or the titles bestowed on us, but how that patient feels and perceives the value of the care we provide. This outcome can only be achieved with being efficient in how we learn and apply right from the start, not only in physical therapy classes in school, but in affiliations and in residencies and continuing education.

Technology can help bridge the gap and smooth the transition. This past year, I made an effort to tune in to as many webinars as I could. For example, the free webinars offered jointly by the *Journal of Bone and Joint Surgery* and the *Journal of Orthopaedic and Sports Physical Therapy* were well worth a try. I enjoyed the required reprint articles prior to the webinar and then the interactive moderated sessions followed by selected questions from the registrants. One hour of this varied format during the evening, along with the ability to archive and retrieve the event for months later and I felt pretty good about the time spent, while learning on my own time and travel constraints.

Sure, the structure of academia and physical therapy curricula is slowly changing, and there are glimpses of keeping up with new learning styles to meet the needs of today's generation of aspiring professionals. But does this mean we are truly fostering preparation in a dynamic, and sometimes, chaotic health care climate? I am not convinced collegiate learning really prepares the new physical therapy graduate optimally. Professors and program chairs struggle constantly to meet academic regulations on credits/workloads, and CAPTE standards, along with satisfying partnerships in clinical education. Depending on where you sit (student, professor, clinician), I am sure you have your own colorful opinion of the disconnection that can and has occurred in your career.

In the era of pushing evidence-based practice up or down the learning chain, we have a long way to go. Trying to scale this movement is difficult. The dance between standards of care and our perceived need to spread our clinical wings to balance art and science continues. Will the two worlds ever meet and allow for a new research clinician who can go from thinking to doing and back again without getting tangled up in the process? Time will tell.

Paris Distinguished Service Award Lecture

James J. Irrgang, PT, PhD, FAPTA, ATC

The Paris Distinguished Service Award lecture was presented at the Combined Sections Meeting in Indianapolis, IN this past February. The lecture as presented by Dr Irrgang with the slides can be viewed at https://orthopt.org/content/membership/publications/current_issue

Innovations and Implementation Strategies for Assessing and Improving the Value of Care Provided by Physical Therapists

I would like to thank the Awards Committee and the Orthopaedic Section Board of Directors for this distinguished award, which I am honored to receive. This award recognizes service to the Section and I have greatly enjoyed all of the opportunities that I have had to serve the Section and its members.

In this lecture, I am going to address the value of the care that is provided by physical therapists and the innovations and implementation strategies that are necessary to be able to more efficiently *measure* and *improve* the value of care that we provide. The reason for my focus on value is because it is widely acknowledged that in the future (perhaps more accurately, in the immediate future or in some cases *NOW*) payment will not be dependent on the volume of the services that we provide, but rather the *VALUE* of our services. Quite simply, in the future it is expected that those that provide greatest value will receive greatest rewards, either through salary incentives for individual PTs or increased reimbursement to organizations that provide the highest value of care through tiered reimbursement rates.

Value is the ratio of the benefits of the care divided by the costs for those services. From the patient's perspective, those costs are the charges that they incur for PT.

In his 2001 Malely Lecture, Dr. Anthony Delitto illustrated the concept of value using the example of the statistics found on the back of a baseball card, likening value to a baseball player's batting average. The "PT Scorecard" includes the number of patients treated (or at bats), risk adjustments (or walks), mean change in outcome per patient (hits), number of visits and change in outcome per visit (or batting average).

As can be seen in this slide, it is possible to detect differences in the "batting average" between physical therapists. These data are from 3 un-identified PTs that participated in the Orthopaedic Section's Neck Pain Pilot Project for the Outcomes Database.

The first PT reported data for 16 patients and the average change in the Neck Disability Index was 17.8. This PT treated patients for an average of 3.2 visits, resulting in an average change in the NDI of 5.6 per visit.

The patients seen by the second PT were more severely involved as evidenced by the higher baseline NDI scores, but the average change per patient was only 5.2. This PT saw patients for an average of 1.9 visits and the change in NDI per visit was 2.7.

The NDI for the last PT improved by an average of 9.2 and on average each patient was seen for 5.2 visits resulting in an average NDI change of 1.8 per visit.

The question becomes, which PT would you most want to see as a patient with neck pain? Or as a clinic manager, which PT would you most like to hire for your clinic?

The challenge ahead of us is to be able to identify those physical therapists or organizations that provide the greatest value, which is akin to identifying what Atul Gwande called a "Positive Deviant." A positive deviant is an individual or organization that is able to find better solutions for problems than their peers. Once a positive deviant is identified, it is necessary to discover the behaviors and strategies that they used to achieve their high level of performance. Once this is understood, it should be possible for others to model the positive deviant's behavior to improve their own performance.

This slide describes the interventions used by the 3 PTs that we previously considered.

The first PT utilized cervical and thoracic mobilization and manipulation for almost all patients, while the second PT used mobilization and manipulation less often. The third PT used mobilization and manipulation, but not as often as the first PT.

Traction was most often used by the third PT, whereas the other 2 PTs rarely used traction.

The third PT also used physical agents with all patients.

The question is, "Are these variations in treatment warranted and are the outcomes achieved by each PT related to this variation in treatment or due to some other factors.

To illustrate the true essence of a "positive deviant" all one has to do is to consider the practice and influence of the late Richard E. Erhard, PT, DC. Dick as he was known to many of us, was unique in his ability to diagnose and treat patients in a manner that exemplified high-value care. Dr. E. greatly influenced the value of care provided by countless physical therapists who personally trained under his mentorship.

In his 2012 McMillan Lecture, Dr. Alan Jette stated that "Physical therapists must become equipped with the skills necessary to function effectively within a health care system to identify *what works*, for *what conditions*, *under what circumstances*, and *at what costs*? Furthermore, he indicated the skills to achieve this goal are: (1) the knowledge of and ability to apply the principles of evidence-based practice; (2) an interest in and use of data and (3) the ability to recognize and develop solutions for problems uncovered by the data.

The UPMC Centers for Rehab Services and Department of Physical Therapy at the University of Pittsburgh have a long history of developing and reinforcing these skills in our clinicians and students. I would now like to elaborate on some of these experiences.

Upon the merger of PT services at the UPMC with a private practice in Pittsburgh to create the Centers for Rehab Services in 1997, the late Richard W. Bowling, PT, MS, CEO of the new entity, emphasized the commitment to collection and analysis of patient outcomes data as the standard for the organization by figuratively stating, "If our PTs cannot demonstrate their outcomes, they should not get paid."

As the Vice President of Quality

Improvement and Outcomes for this newly created organization, I took this to heart and developed a process to collect patient outcomes data throughout the episode of care. The intake form included collection of demographic information, health history, prior and current activity level, employment status, region specific patient-reported outcome measures, the SF-36, pain scale and pain diagram. All told, the intake form was 12 to 14 pages long. On a weekly basis, we readministered the region specific outcome measure, SF-36, pain scale and a pain diagram. At discharge, we collected present activity level and work status, re-administered all of the outcome measures and a patient satisfaction survey. Given this amount of information that we tried to collect, how successful do you think this process was?

The forms were created using Teleforms software so that the forms could be scanned or faxed into a central database. We also created a customized software program that would electronically send and print the forms at each clinic based on the patient schedule. This routine ran overnight so that the forms were printed and ready in the morning when the office staff arrived. To determine when a follow-up form was needed, the system scanned the appointment schedule and outcomes database to determine if there was outcomes data within the last 7 days. If there was no outcomes data, another follow-up form was printed. The forms were attached to the patient charts and distributed to patients as they arrived to the clinic. Once completed, the forms were faxed back to the central database.

So how well did this process work? We obtained baseline data on 50% to 60% of the patients and follow-up data on 30% to 40% of the patients. Despite high level support from senior management, we were unable to improve upon this response rate. Physical therapists were able to retrieve a summary of outcomes data for individual patients to track their progress over time; however these summaries were not frequently used. Furthermore, while it was possible to aggregate data over patients to evaluate clinician and organizational performance, it was very time consuming and labor intensive to do so.

Because there were technical difficulties in scanning data into the database, a positive feedback loop was created resulting in forms being printed when the data had already been collected. This resulted in staff frustration and the killing of large numbers of trees!

Today, within CRS, outcomes data for all patients continues to be collected and used to assess individual patient progress and inform clinical practice; however, it is stored in the patient's chart making it difficult to aggregate data for performance and quality improvement initiatives.

Under the leadership of Dr. Delitto, CRS has been able to successfully collect classification, treatment and outcomes data for patients with low back pain. "Electronic forms" have been created for physical therapists to manually enter data into a centralized data base. With close oversight of the process, they have been able to achieve greater than 80% compliance with data collection. More importantly, the data have provided important information to inform the role of physical therapy in the UPMC Health Plan's value-based low back initiative.

Overall, within CRS there has been an ongoing interest in and use of outcomes data. While there have been many successes, challenges continue to exist in collecting, analyzing, and interpreting these data. However there is a strong organizational commitment to continued improvement in these processes.

Collection and analysis of process of care and clinical outcomes data has also been an important part of the clinical education program for PT students at the University of Pittsburgh since our transition to the Doctoral degree in 2003.

During the final year of education, students at Pitt complete a year-long clinical internship and are required to complete a longitudinal performance improvement project. Students start the clinical internship in May. Starting in June, students begin to collect process of care and clinical outcomes data for all of the patients that they treat over a 3 month period of time. In the fall term, they analyze and interpret their data with a focus on identifying opportunities to improve their clinical performance.

To develop the skills necessary to solve problems uncovered by their data, the students reflect upon their clinical performance by critically evaluating their patients that did not achieve a meaningful outcome to determine factors that are associated with the poor outcome and alternative approaches that might be used with similar patients in the future. Additionally, they critically evaluate their adherence to clinical practice guidelines.

The results of this self-reflection are used to develop a performance improvement plan that is implemented in the last semester of the internship. This requires them to collect data for an additional 3 months to analyze the effectiveness of their plan.

We believe that this project provides our students with the skills that Dr. Jette indicated are necessary for physical therapists to provide high-value care in today's challenging health care environment.

In this project, we emphasize that the data that are collected should be limited to the data that are ordinarily collected in the course of providing care to patients. However, I am sure that our students will tell you that it is a time-consuming and arduous process because it requires them to manually record and enter data into a database that they developed, after already documenting this information in the patient's chart. Additionally, they have to learn to use a statistical software program and write code to analyze their data. So while we are training our students to have an interest in the use of process of care and clinical outcomes data to evaluate and improve their clinical performance, we would be foolish to believe that they continue to do this routinely upon entering clinical practice due to the lack of systems and technology that fosters the collection and analysis of this data.

One of the objectives in the 2010 Orthopaedic Section Strategic Plan was to "Develop a National Orthopaedic Physical Therapy Outcomes Database (NOPTOD)." The first step in achieving this objective was to conduct a pilot project to determine the feasibility and interest in collecting process of care and clinical outcomes data by members of the Orthopaedic Section.

This pilot project was centered on the Neck Pain Clinical Practice Guidelines that were developed and published by the Section in 2008. The guidelines were used to create forms that included information related to the episode of care, patient characteristics, symptoms, examination findings, classification, interventions, and clinical outcomes.

Thirty-eight PTs from 36 clinics contributed data on approximately 250 patients with neck pain over a 6 month period. A complete summary of the project was published in Orthopaedic Physical Therapy Practice in 2014.

A follow-up survey was conducted to determine the burden of collecting and the usefulness of the data. The primary motivations for participating in the project were to enhance professional development and

to obtain feedback to improve clinical performance. The summary of information provided back to the PTs that participated in the project was rated as extremely valuable by 75% of survey respondents and 95% would be willing to participate in the National Orthopaedic Physical Therapy Outcomes Database in the future. Suggestions to make participation in the Outcomes Database more useful included integration of data collection with the electronic medical record, the ability to generate on-demand summary reports for individual patients or groups of patients, and the ability to benchmark results against national data.

Based on the success of this pilot project, the Orthopaedic Section Board of Directors voted to proceed with development of an electronic data capture system for neck pain and to proceed with development of the project for patients with low back, shoulder, and knee pain. Additionally, the Section is exploring integrating the National Orthopaedic Physical Therapy Outcomes Database with the Physical Therapy Outcomes Registry that is being developed by the APTA.

Upon reflection on these experiences with the collection and analysis of process of care and clinical outcomes data to assess value, there are many lessons that have been learned.

First, successful collection and analysis of data needs to become engrained in the culture of the organization. To do so, requires a systems-based approach to implementation of data collection that considers the perspectives of the organizational leadership, professional and support staff, patients, and payers in a combined top-down bottoms-up approach to implementation.

A *key step in implementation* is for all stakeholders to have a clear understanding of the usefulness and importance of the data. Compliance with collection of outcomes data is greatly influenced by the way the information is presented by the physical therapy staff to the patients. If the staff and patients understand the usefulness and importance of the information, patients are more likely to take the time to complete forms. Patients need to know that the information will help their PT better understand their condition and to monitor their progress. Physical therapists need to review the results with the patient and use the information to inform clinical decision making and evaluate patient progress. It needs to be clear to all, that this process of data collection and analysis is **NOT RESEARCH**, but rather an important part of today's clinical practice. **Collection of outcomes data will fail if the patients and front-line professional and support staff do not understand the usefulness and importance of the information**.

Second, when implementing an outcomes data collection process, you need to carefully consider the amount of information that is being collected. Only that information that is needed to inform clinical decision making and performance and quality improvement initiatives should be collected. This information should be linked to evidence-based clinical practice guidelines such as those developed by the Orthopaedic Section.

Key physical therapy staff should be involved in the planning and implementation phases to ensure that the information to be collected is clinically relevant and places minimal burden on the patients and the staff. Processes for data collection should be seamlessly integrated within routine practices within the clinic, utilizing support staff as necessary. The use of tablet computers in the clinic and secure web-based patient portals to collect patient-reported outcomes without the need for patients to return to the clinic will improve compliance with data collection and minimize burden for data entry and scoring.

Meaningful development and use of electronic medical records should include all of the essential data elements that are necessary to evaluate and identify opportunities to improve the value of our care. These data elements should be consistent with the information that is needed for documentation purposes. EMRs have not been developed to serve as an outcomes registry. Rather, once documentation is entered into the EMR, the data elements necessary to measure value should be electronically migrated into a centralized outcomes registry, such as that currently under development by the Orthopaedic Section in collaboration with the APTA. This connection between the EMR and an outcomes registry is necessary to avoid duplicate data entry and to streamline aggregation and analysis of the data.

To make the process of data collection meaningful, summaries of the data must be immediately available for use by the PT. This includes the ability to generate reports for individual patients, summarizing the patient's progress or lack thereof for use in clinical decision-making and communication with others involved in the patient's care.

Additionally, PTs and clinic managers must be able to generate reports summarizing aggregate data. This should include information related to the process of care, including the duration and number of visits, interventions provided, adherence to clinical practice guidelines and a summary of clinical outcomes.

It should be possible to summarize this information across all patients was well as for specific patient classifications, for example, summarizing outcomes for patients with "neck pain with mobility impairments." Benchmark reports should allow individuals to compare their performance against their local and national peers. In the future, procedures to "risk adjust" the results will be necessary to ensure valid interpretation.

My last comment regarding the assessment of value is that we need to carefully consider the selection of the outcome measures that are utilized. We need to strive for the use of a "Common Currency" when measuring outcomes. That is we must utilize measures that are standardized to ensure the ability to compare our results with others. This has been an important recommendation that is included in the Clinical Practice Guidelines that have been developed by the Orthopaedic Section.

Recently there have been advances in measurement theory that have allowed for the development of computer adaptive tests to measure patient-reported outcome. Computer adaptive tests allow for more efficient measurement of outcome by tailoring the administration of the questions to the individual and their responses to prior questions. Examples of CATs to measure patient-reported outcomes are the AM-PAC, developed by Dr Alan Jette and the CATs developed by the PROMIS Network.

While promising, evidence related to the reliability and responsiveness of the CAT scores is needed to support their interpretation and use. Additionally, efforts are needed to imbed the computer algorithms that are necessary to administer a CAT within the EMR. In the meantime, short form versions of the CAT that can be administered as paper-based or computer-administered outcome measures may help improve and standardize measurement of patient-reported outcomes.

I would like to use the last few minutes of time to discuss my thoughts on the innovations in clinical practice that are needed to improve the value of care that we provide to our patients. The pressures driving reduced utilization of physical therapy, including fewer covered visits and increased out-of-pocket expenses for patients are a threat

to the quality of care that we provide. We cannot let this affect the value of our care.

Innovations in clinical practice are needed to improve or maintain the value of physical therapy. To achieve this, we either need to decrease the costs of our services and/or improve the benefit that we provide to patients. How can this be achieved?

First, we need to utilize the best available evidence, coupled with our expertise in diagnosis, prognosis and treatment and the patient's values and wishes to make the best decisions for the care of individual patients. Use of and adherence to clinical practice guidelines enables a PT to recommend the most optimal treatment for an individual patient. Unfortunately, despite best intentions, adherence to clinical practice guidelines is less than optimal.

For example there is reluctance of some physical therapists to use manual therapy procedures, including thrust mobilization for treatment of acute low back pain despite the evidence indicating its benefits. If this is due to lack of awareness or recall of the guidelines, than innovations in technology, such as inclusion of decision support systems within the EMR may help to alert PTs of high-value, evidence-based treatment options as information from the history and examination are entered into the EMR.

If the reluctance to use thrust mobilization for the treatment of acute low back pain is due to lack of expertise and experience, than additional clinical training becomes the solution. This may include specialty training through participation in a residency or fellowship program or attendance of continuing education programs that offer hands-on training, such as that available at the Orthopaedic Section's Annual Meeting.

When faced with pressure to decrease the number of visits, rather than accepting that this will result in a less than optimal outcome for the patient, we need to explore alternative care delivery models. An example of this is the work that Dr. Sara Piva is doing at the University of Pittsburgh. Currently she is conducting a patient-centered comparative effectiveness trial to compare intensive exercise supervised by a physical therapist to group exercise in a community center or usual care for late stage rehabilitation after total knee arthroplasty. The results of this study will help to identify the value of these treatment approaches and may provide physical therapists with an alternative care delivery approach to maximize value after total knee arthroplasty.

The use of new and developing technologies may also enhance the value of physical therapy in the face of pressures to reduce the utilization. With funding from the Coulter Foundation and the Pitt Innovation Challenge, we are developing the interACTION (iA) system, which is a portable joint function monitoring and training system for remote rehabilitation. Sensors, placed on either side of the knee collect motion and position data which is stored on a smartphone or tablet and can be analyzed and displayed in patient or therapist modes. It is intended that this system will be used to supplement and monitor compliance with the patient's home exercise program.

In competing for funding from the Coulter Foundation to support the development of interACTION, we were challenged with creating a business model that would be attractive to future potential investors. How could PTs generate additional revenue by charging for the use of this device? Why would PTs want to use this technology that would replace the generation of PT charges? These questions are only applicable if you are working in a setting that rewards quantity of service not the value of service.

To address this issue, Coulter required us to develop a "Killer Experiment." To evaluate the value of the interACTION system we will conduct a randomized trial to compare standard outpatient physical therapy at a frequency of 2 times per week against outpatient physical therapy at a frequency of 1 time per week supplemented by use of the interACTION system in patients following total knee arthroplasty. The outcome for the study will be a comparison of the differences in value between these 2 approaches in terms of improvement in patient-reported and performance-based measures of physical function divided by the costs of treatment, including the cost of the interACTION system. We believe that even considering the cost of this technology, use of the interACTION system could lead to the same or better outcomes with decreased costs.

In an accountable care organization, in which you receive a bundled fee for rehabilitation of the patient, the clinic would come out ahead if the use of this technology allows you to achieve the same or better outcomes with decreased utilization of PT services. Additionally by demonstrating that use of this technology leads to better clinical outcomes, the clinic may be able to negotiate a higher tiered reimbursement rate for management of patients after total knee arthroplasty.

In closing, I believe that the future is bright for those physical therapists and organizations that as Dr. Jette would say are **Prepared to Face into the Wind**. However to do so, requires the commitment to endorse, support and utilize innovations and systems-based implementation strategies to assess and improve the value of care provided by physical therapists.

I would be remiss by not recognizing those that have made my service to the Section a rich and rewarding experience. In particular, I would like to thank the members of the Orthopaedic Section that gave me the opportunity to serve the Section and the profession. In particular, I would like to recognize all of the Board colleagues, Committee Chairs and Members, and Section staff that have provided support of my service to the Section, for without which my success would have been limited. I also want to recognize my colleagues at the University of Pittsburgh and the UPMC Centers for Rehab Services including Anthony Delitto, Kelley Fitzgerald, Sara Piva, Kathy Kelly, Paul Rocker, Tara Ridge, Freddie Fu, Chris Harner, and many others for the inspiration and creativity of ideas that they have provided over the years. I also want to recognize my prior mentors who are no longer with us, including Tim Kerin, Rick Bowling, and Dick Erhardt who have had a great influence on the person and professional that I am today.

Lastly, I could not have provided the service to the Section without the loving support of my family including my wife, daughter and son-in-law, son and daughter-in-law, and 6 grandchildren. Thank you.

Utilization of a Three-Dimensional Mobility Progression, "The Z Route," in Shoulder Rehabilitation

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ABSTRACT

Background: Restoration of passive and/or active elevation is a common goal in shoulder rehabilitation. External rotation plays an important role in this dynamic process and is a necessary precursor of elevation gains. This motion coupling may be limited due to muscle length restrictions, focal impingement, glenohumeral capsular mobility loss, rotator cuff pathology, or postoperative healing constraints. **Purpose:** To describe an ideal 3-dimensional motion pathway to regain shoulder elevation. This pathway may serve as an origin to initiating strengthening progressions for the shoulder. **Methods/Findings:** The author proposes a motion pathway, based on the application of known shoulder biomechanics, to be used with the goal of maximizing mobility and functional outcomes while minimizing comorbidities. **Clinical Relevance/Conclusion:** Maximizing function is the paramount goal of the rehabilitation process. The implementation of the mechanically based "Z Route" to restore shoulder elevation can help minimize treatment co-morbidities and thus, speed the time of short- and long-term mobility goal attainment.

Key Words: shoulder therapy, elevation, external rotation

HISTORICAL PERSPECTIVE

A significant portion of the present day shoulder literature focuses on exercise (and protocols thereof), biomechanical function of the various joint structures (ST, AC, SC, GH), and subacromial regional therapies, including mobilization and stretching.[1] Beyond referencing "motion in the plane of the scapula,"[2-7] there is little discussion with respect to a specific protocol for the progressive restoration of 3-dimensional motion during the shoulder rehabilitation process. Donatelli et al[8] introduced biomechanically-sound suggestions for shoulder rehabilitation which serve as a basis for the concept described in this paper. The concept, hereafter defined as the "Z Route," attempts to restore maximal elevation while minimizing secondary morbidities that are often the product of overaggressive therapeutic intervention.

Z ROUTE ORIGINS

Subacromial pain[9] due to mechanical impingement may serve as a persisting inhibitor of motor function through mid-ranges, resulting in compensatory movement patterns and activities of daily living dysfunction.[10,11] This impingement often results from the tendency excess can originate. Used in conjunction with a mechanically based examination, the "Z Route" serves to reduce the possibility of secondary co-morbidities during the rehabilitation process by minimizing capsular twisting and subsequent tuberosity impact.[12]

The Clinical Perspective for Utilization

From clinical experience, two of the more common issues that fail to be completely resolved in the rehabilitation process are as follows: First, restoration of the static (capsular) and dynamic (humeral depressor strength) components[16] of mid- and end-range elevation, particularly in the frontal plane.[13] Second, restoration of inferior translation of the greater tubercle as external rotation (ER) is reintroduced through the process of elevation restoration.[1] Following surgical intervention, trauma, or insidious onset of symptoms, insufficient resolution of these two issues often leads to persistent low-grade symptomology, due to encroachment in the subacromial region. By using the "Z Route," the frequency and intensity of bony and soft tissue contact in the subacromial space is decreased, thus reducing therapist-induced encroachment. As such, the internal healing environment within the joint is potentially enhanced, which is advantageous with regard to minimizing noxious or mechanical stimuli. The patient's home exercise program may be similarly modified to follow the "Z Route," again minimizing joint irritation or reinjury.

A crucial paradigm of any rehabilitation program is that strengthening activities must be functionally and mechanically sound to avoid dysfunction. Initiating exercise and/or mobilization patterns[17] progressively from the main artery "Z Route" serves to minimize shear and longitudinal stress placed on the shoulder structure in this supine, fully supported, gravity-eliminated position. With an underlying knowledge of soft tissue healing constraints and mechanical function, the therapist assists the patient, using passive and active assistive motion, as necessary, along the "Z Route." Progression of strengthening activities (whether isometric or isotonic) closely follows into the realm of newly established, mechanically sound motion. As such, exercise (ie, isometrics/tonics neuromuscular kinesthetic) may be started soon after surgical intervention at the starting point of the "Z Route."

Of note, the loss of shoulder extension with or without internal rotation can also lead to pathology and impairments in activities for daily living (ADLs). If this limitation is present, it can be simultaneously addressed as an adjunct phase of the "Z Route;" however, this limitation is not described in this paper. With respect to ADL impairment, elevation (and ER) restoration is advantageous due to the fact that the majority of ADLs are performed in front of the body, progressively overhead, as opposed to the few times during a day when the arm is required to move into internal rotation or behind the frontal plane (ie, donning a shirt or toileting.)

The "Z Route" is incorporated with the assumption that there is underlying stability from the cervical spine and peripheral neurologic structure, as well as adequate stability/mobility about the thoracic spine, costovertebral joints, scapula, and clavicle. If any of these structures are impaired, they are addressed via formal examination.

THE Z ROUTE DEFINED

An example of the 4 points of the "Z Route" is described for the patient with an involved right upper extremity. Note that these are points in space, not motions. As such, the patient's humerus moves through space to take the most direct route from one point to the next.

1. In supine, maximal abduction up to 90° and maximal ER in the frontal

plane. The elbow is bent to 90° to minimize unnecessary tension from the biceps.

2. In supine, 90° elevation in the sagittal plane, elbow bent to 90°.
3. In supine, 120° elevation, just anterior to the scapular plane (10:00 position for the right upper extremity).
4. Sidelying with progressive motion overhead, migrating toward elevation in the frontal plane, and once accomplished, in the sagittal plane.

Progression through the stages of the "Z Route" continues as long as there is no excess anterior/superior migration of the humeral head (potentially creating subacromial impingement), or excess lateral migration of the scapula.[12] This excessive migration is determined through visual perception, manual palpation of the joint motion, and/or the patient's verbalization of focal pain (at times, indicative of superior and/or anterior migration of the humeral head). Successful completion of the "Z Route" indirectly correlates to the magnitude and chronicity of range of motion restriction due to existing bony and soft tissue change. Rehabilitation through the "Z Route" may require many months to accomplish, particularly with cases of adhesive capsulitis.

As previously stated, a primary goal in shoulder rehabilitation is maximizing elevation, which correlates with ADL function. External rotation is necessary to achieve this. Although feasible in all situations where mobility gains are desired, the "Z Route" is specifically indicated when progression into pure ER becomes restricted due to bony or soft tissue encroachment (the greater tuberosity of the humerus cannot clear underneath the acromial arch), or is contraindicated per physician's protocol. As the patient progresses through positions 1 through 3 of the "Z Route," a mechanical advantage toward ER is achieved, due to positioning of ligamentous restraints in the glenohumeral joint. Once these positions are completed, progressive overhead motion can be initiated (position 4), and goals for functional shoulder elevation can be met.

Position 1 (Figure 1) is defined as the point of maximal abduction to 90° and maximal ER in the frontal plane (or, if pain or motion limitation is present, just anterior to frontal plane, with support of the elbow off of the treatment table on a pillow or foam roll). From a soft tissue perspective, motion limitations (further abduction and ER) in this position would originate from the inferior glenohumeral (IGH) ligament, and to a lesser degree from the superior glenohumeral (SGH) ligament, anterior coracohumeral (ACH) ligament, and middle glenohumeral (MGH) ligament.[18] Common dynamic soft tissue constraints in this position include the pectoralis major, subscapularis, teres major, and latissimus dorsi.

When the clinician is no longer able to gain passive ER in this position, the humerus is directed toward position 2 (Figure 2) which is 90° of elevation in the sagittal plane. Passive soft tissue constraints that limit further motion into ER in position 2 include the IGH, MGH, ACH, and SGH ligaments. Soft tissue constraints now include the pectoralis minor as the scapula begins to upwardly rotate.[15,19]

Along this path (from position 1 to position 2), there will be a point at which the tuberosity may clear underneath the acromion. At this time (again supported by either the therapist's hand or pillow), ER motion is again attempted using an active or active assistive pattern. Once ER availability is maximized at position 2, the clinician attempts to move the limb towards 120° of elevation anterior to the plane of the scapula (10:00 arm position for the right shoulder). This pattern will allow the greater tuberosity to migrate away from the undersurface of the acromion, enhancing the potential to regain ER in mid-range due to diminished longitudinal tension on the superior cuff as well. This is crucial following postoperative cuff repair.

Migration toward the frontal plane will cross the plane of the scapula. An and colleagues[20] describe that motion just anterior to the frontal plane is the biomechanically ideal plane of which to progress with overhead motion. This is position 3 (Figure 3).

Once position 3 has been attained, there is now adequate ER to progress further overhead into elevation. The patient is turned to the contralateral sidelying position, which allows the scapula to move more freely in space, as opposed to being in contact with the treatment table surface. The humerus is directed overhead, initially in the plane immediately anterior to the plane of the scapula and to progressively higher angles of elevation moving toward the frontal plane. This process continues until full elevation and appropriate inferior migration of the humeral head have been restored. This is position 4 (Figure 4). Scapular movement is also easily monitored in this sidelying position by palpation of the lateral scapular border, noting that a tight inferior joint capsule and/or teres musculature may result in lateral movement of the scapula on the thorax. Underlying static or dynamic soft tissue mobility loss can then be addressed using soft tissue mobilization techniques.

Once position 4 has been attained, additional ER gains, progressively toward the frontal plane (using passive, active assistive and active range of motion or contract relax patterns and muscle energy technique) are attained with greater ease, due to the diminished motion restrictions of the scapula in sidelying. The sidelying position also allows for minimal shear across the surface of the glenoid and superior cuff musculature is less tensioned, advantageous

Figure 1. Position 1; maximal abduction.

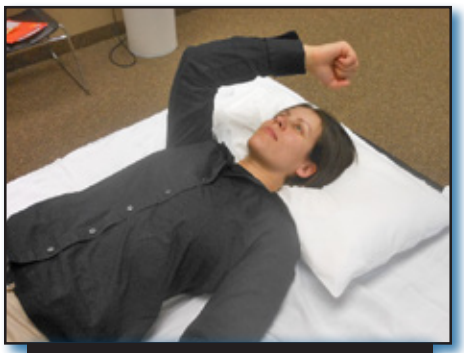

Figure 2. Position 2; 90° flexion in the sagittal plane.

Figure 3. Position 3; 120° abduction toward the frontal plane.

Figure 4. Position 4 movement overhead anterior to the scapular plane.

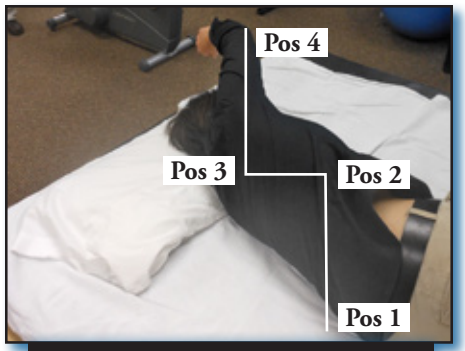

Figure 5. Synopsis of the 3 points inverted with respect to the right shoulder.

from both a movement and strengthening perspective.

As elevation and ER improves in position 4, the therapist may choose to return to a position of 90° of abduction in the frontal plane to further initiate mobility and strengthening patterns, (now in close proximity of attaining 90° ER in the frontal plane at a point of 90° of abduction while supine). Once ER has been fully attained at a particular point along the "Z Route," the goal is to reverse the direction to improve ER at the lower positions along the "Z Route" until ER is once again attained with the patient's shoulder in 90° abduction in the frontal plane. A synopsis of these 3 points allows one to appreciate the "Z Route" of which the letter Z is actually reversed for the right shoulder normally positioned to the left (Figure 5).

SUMMARY AND CONCLUSIONS

The protocol for orthopaedic shoulder rehabilitation has been 3-fold; exercise and particularly improved functional strength about the scapular stabilizers, stretching, and to a lesser extent manual technique such as mobilization. Lacking from this group of treatment parameters is the establishment of a biomechanically sound, 3-dimensional movement pattern to expedite the restoration of elevation from the sagittal to frontal plane. Again, this is important with respect to minimizing co-morbidities during the subsequent implementation of the exercise and/or mobilization.[12]

Creating and maintaining an environment of maximal healing is a crucial aspect of the rehabilitation process. Controlled motion along the "Z Route" enhances this process. This is an advantageous concept to adopt with the appreciated complexities of the shoulder girdle, being cognizant of the establishment of functionally sound mobility prior to the implementation of static and dynamic strengthening. The concept of the "Z Route" is important not only for injuries to the rotator cuff, but other types of pathology for the shoulder since the biomechanical premise is the same regardless of the injury.

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Work-related Performance in Men with Traumatic Osteomyoplastic or Conventional Transtibial Amputation

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ABSTRACT

Background/Purpose: Men with transtibial amputation due to trauma (TTAT) struggle at work due to residuum injury. Untoward residuum-socket interface (RSI) loads and residuum muscle activity (RMA) are suspected injury-causing mechanisms which may differ by amputation approach (conventional, osteomyoplastic). Physical therapists could reduce risk if mechanisms are examined during performance. Residuum-socket interface loads and RMA were examined in men with TTAT (conventional, osteomyoplastic) during work-related activities. **Methods:** Lifting, RSI load, and RMA during 2 walk speeds and carrying were examined in 4 men with TTAT (conventional=2, osteomyoplastic=2). **Findings:** The osteomyoplastic dyad had greater: residuum dimensions; perceived function; walking and lift capacity; and generated larger, consistently-distributed RSI loads. Osteomyoplastic RMA was greater than intact limb activity and conventional TTAT during self-paced walk and carry; gastrocnemius co-contracted during tibialis anterior activation. **Clinical Relevance:** Physical therapy specific to amputation type warrants consideration. **Conclusion:** Residuum loading and RMA differed between osteomyoplastic and conventional dyads during work performance.

Key Words: work-related activities, gait, residuum loading, residuum muscle activity

INTRODUCTION

The majority of adults who undergo transtibial amputation due to a traumatic event (TTAT) are otherwise healthy men of working age.[1,2] Unfortunately, in spite of successful recovery from the amputation surgical procedure,[2] these men still struggle to participate in the labor force,[3] implying that physical therapy intervention may not be meeting the long-term goals of workers with TTAT. Residual limb injury suffered during performance of work-related activity (WRA) may be a significant and daunting barrier to labor force participation.[3] Two factors that plausibly explain causes of injury are: (1) excessive or poorly distributed weight-bearing load at the residuum-prosthetic socket interface (RSI), and (2) inappropriate or inadequate muscle activity in the distal residuum (RMA) during active prosthetic use.[4-6] However, 2 types of transtibial amputation procedures, conventional and osteomyoplastic, may require respectively different rehabilitation approaches. Before effective physical therapy intervention can be determined to minimize risk of residuum injury, these mechanisms must be examined in working-age individuals with TTAT during actual WRA performance.

There are two approaches to transtibial amputation performed in this population, conventional (C-TTAT) and osteomyoplastic (O-TTAT). The C-TTAT approach is a more commonly performed procedure in which the tibia and fibula are amputated approximately 7 inches distal to the knee joint line. The distal-most muscles are also incised, and the soft tissue is attached as a posterior flap to the anterior-distal residual limb.[7] In contrast, the O-TTAT is a surgical technique in which the medullary canal of the amputated bone is sealed by a periosteal "sleeve" from the distal end of the tibia to the distal end of the fibula. This procedure enables a tibia-to-fibula synostosis to stabilize the bony structures within the distal residuum and allows patients to axially bear weight. The myoplasty then provides the distal-most muscles with the anatomic posterior, lateral, and anterior muscle compartmental attachments, intended to create muscle length-tension stability within the residuum.[8]

There is emerging evidence of differences in RSI load distribution and residuum muscle activity recorded in subjects with C-TTAT and O-TTAT during functional activities. Mai et al[9] studied WRA performance in 10 men with unilateral TTAT (C-TTA=1; O-TTAT=9) and found antagonist co-contraction of the residuum gastrocnemius and tibialis anterior muscles during stance phase of gait. Analysis further confirmed presence of axial loading at the distal residual limb and an apparent residuum muscle length-tension relationship.[9] Mai et al[9] proposed that these outcomes were attributable to the O-TTAT procedure, due to the greater number of O-TTAT participants in the subject sample. Further, Mai et al[9] postulated that muscle activity in the distal-most residuum may be linked to the variation in distal RSI load and thus associated with the actual gait activity.

In a cross-sectional study, investigators examined performance in comparable groups of working age men with transtibial amputation due to trauma (TTAT, n=10) and intact controls (n=30).[10] All subjects underwent self-paced and brisk Two-Minute Walk Tests (2MWTs),[11] 25-foot carry,[12] and floor-to-knuckle lift tests,[12] as well as blood draws for biomarker detection of inflammation[13] and bone degradation.[14] Results showed that both groups were comparable in age, height, weight, and in distances walked, with little-to-no evidence of pathological inflammation or bone degradation. However, participants with TTAT lifted ($p = .028$) and carried ($p = .008$) significantly less weight than their non-amputee counterparts.[10] These findings bring to question physical therapy rehabilitation methods traditionally focused on gait training, with possibly insufficient attention directed towards more specific work-related activity training in clinical or wellness settings.

In a 3-year study of men with TTAT, the investigators also noted possible differences

in residuum muscle activity (RMA) and RSI load in participants with C-TTAT and O-TTAT (C.P. Dionne, unpublished data, October 2014). The purpose of the current study was to examine gait performance, RSI load distribution, and lower limb muscle activity during WRAs in similar subjects with unilateral C-TTAT or O-TTAT.

METHODS

The investigators selected de-identified data from two men with C-TTAT and two men with O-TTAT, who were otherwise healthy, formally consenting participants in an ongoing, prospective study approved by the university institutional review board for protection of human subjects. Descriptive and self-reported (Locomotor Capacity Index-5, LCI-5,[15] and Prosthetic Evaluation Questionnaire, PEQ[16]) data were compiled and tabled according to amputation approach (C-TTAT, O-TTAT). The LCI-5 is a validated, 10-item questionnaire that measures perceived mobility in people with lower limb amputation.[15] The PEQ has been validated for content and temporal stability in respondents' quality of life (mobility, psychosocial and general well-being), regardless of age or level of lower limb amputation.[16]

Residuum-socket interface load and EMG sensors[9] and portable gait sensor array (MiniSun IDEEA™) recorded participant performance of: (1) self-paced 2-Minute Walk Test (2-MWT), (2) brisk 2-MWT, and (3) 25-ft carry (Figures 1 and 2). The 2MWT has been found useful in determining functional level of walking in patients with lower extremity amputation.[4] Methods of lift and carry testing undergone in this study were from the NIOSH guidelines for functional capacity test protocols.[12] Performance data were analyzed using descriptive statistics, tables, and graphs.

RESULTS

Subject Description

The Table shows data for the subjects in the C-TTAT and O-TTAT groups. There were minimal-to-no differences in age, height, weight, reported pain or work activity level between the 4 male participants. However, the O-TTAT subjects had greater residuum length (by 18.41 cm) and girth (by 8.58cm) than the C-TTAT subjects. The O-TTAT dyad reported a higher perceived ambulatory capacity LCI-5 score (by 14 %), and greater scores in all PEQ subscales (by 9 to 20 units) except for the Ambulation subscale, in which C-TTAT dyad scored 20 units greater. In the appearance subscales, the scores were similar between the 2 dyads.

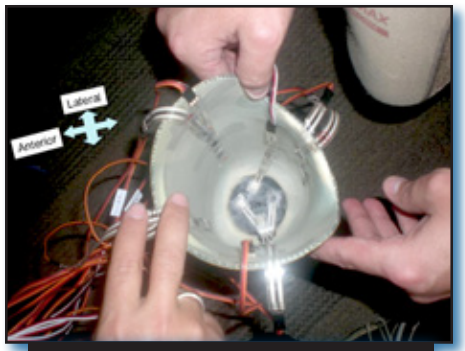


Figure 1. Sensors for load measurement inside the prosthetic socket.[9,10]

Figure 2. Participant undergoing a lift test while being monitored by the OU-PAM.[9,10]

Work Capacity

The O-TTAT dyad walked a greater average distance in both self-paced (by 11.58 m) and brisk (by 48.77 m) 2MWT. The O-TTAT dyad demonstrated greater lift capacity (by 6.81 kg) than the C-TTAT dyad, but C-TTAT dyad demonstrated greater carry capacity (by 4.53 kg).

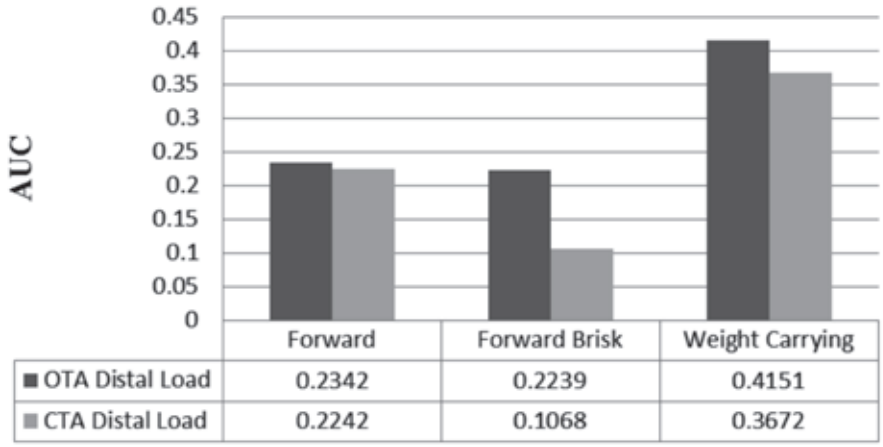
RSI Loads and Muscle Activity

As seen in Figure 3, the O-TTAT dyad demonstrated greater residuum end-bearing loads (lbs) during the self-paced walk, brisk walk, and carry tests, with the greatest difference (AUC = 0.1171*mV-sec*) noted during brisk walking. During the self-paced walk test (Figure 4), the overall O-TTAT residuum muscle activity as determined by the area under the curve (*mV-sec*) was *greater*

Table. Description of Dyads with Transtibial Amputation due to a Traumatic Event (TTAT)

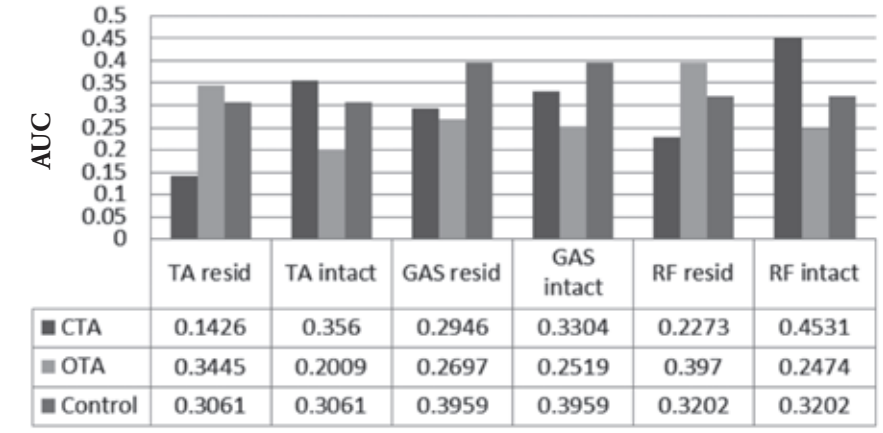
	C-TTAT(n=2)	O-TTAT(n=2)
Age (yrs)	37.00 ± 19.80	37.50 ± 17.68
Height (m)	1.82 ± 0.02	1.85 ± 0.24
Weight (kg)	93.44 ± 7.70	104.33 ± 21.21
Activity Level[12]	Medium Duty	Medium Duty
Median NPRS (0-10/10)	0	1
Residuum Girth (cm)	26.33 ± 4.67	34.91 ± 2.00
Locomotor Capacity Index-5	42.00 ± 19.80	56.00 ± 0.00
PEQ subscales:		
Ambulation (AM)	87.87 ± 10.27	68.10 ± 13.15
Appearance (AP)	82.40 ± 3.68	82.15 ± 17.75
Frustration (FR)	68.50 ± 19.80	77.50 ± 31.11
Perceived Response (PR)	85.90 ± 17.68	97.85 ± 0.78
Residual Limb Health (RL)	44.90 ± 43.70	63.04 ± 20.32
Social Burden (SB)	87.10 ± 16.83	95.49 ± 3.09
Sounds (SO)	65.15 ± 17.89	84.70 ± 19.37
Utility (UT)	66.64 ± 9.53	75.25 ± 9.55
Well Being (WB)	83.45 ± 6.43	94.00 ± 0.71

Values represent Means ± Standard Deviation
Abbreviations: C, conventional, O, osteomyoplastic; NPRS, Numeric Pain Rating Scale; PEQ, Prosthetic Evaluation Questionnaire



Abbreviations: AUC, area under the curve (*mV-sec*); Self, self-paced 2-Minute Walk Test; Brisk, Brisk 2-Minute Walk Test; Carry, 25-ft Carry Test; C-TTAT, conventional transtibial amputation; O-TTAT, osteomyoplastic transtibial amputation

Figure 3. Residuum-socket interface load during 3 work-related activities.



Abbreviations: AUC, area under the curve (*mV-sec*); Self, self-paced 2-Minute Walk Test; Brisk, Brisk 2-Minute Walk Test; Carry, 25-ft Carry Test; TA, tibialis anterior; GAS, gastrocnemius; RF, rectus femoris; CTA, conventional transtibial amputation; O-TTAT, osteomyoplastic transtibial amputation; Control, non-amputee[10;]

Figure 4. Muscle activity during self-paced 2-Minute Walk Test.

than the muscle activity generated in their contralateral intact limbs, most notably in the tibialis anterior and rectus femoris. In contrast, the C-TTAT dyad residuum muscle activity generated was notably *less* than the respective muscle activity in their intact limbs, also in the tibialis anterior and rectus femoris muscles. The O-TTAT residuum muscle activity was similar to the controls in the tibialis anterior and rectus femoris muscles, but less in the gastrocnemius. The C-TTAT residuum muscle activity was less than the controls across all 3 muscles tested. However, as seen in Figure 5, muscle activation was similar across all groups during brisk walking, except for the O-TTAT tibialis anterior activity, which was considerably greater. And again, the O-TTAT muscle activity was greater than the intact limbs regardless of test.

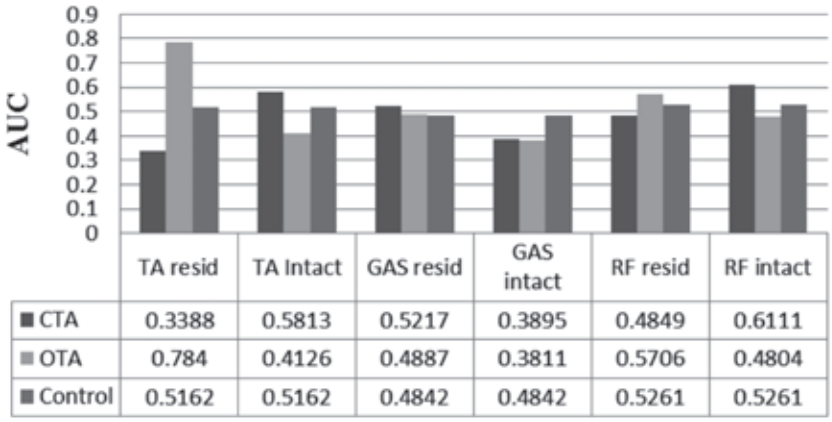
Investigators then examined plotted graphs of RSI load and lower limb muscle activity over the entire gait cycle (stance to swing, left to right) for the self-paced 2MWT, the brisk 2-MWT, and the 25-foot carry test for the C-TTAT dyad (Figure 6) and for the O-TTAT dyad (Figure 7). Muscle activity was also compared with controls.[10] Timing of muscle activation during self-paced 2-MWT, brisk 2-MWT, and the 25-foot carry test also appeared unique to amputation surgical approach. During self-paced walk, brisk walk, and carrying tests, the C-TTAT dyad's residuum muscle activity was not "in phase" with activity in their intact limbs or in the controls' lower limbs. At the initiation of swing phase, the C-TTAT residua demonstrated minimal concurrent rectus femoris-gastrocnemius-tibialis anterior activation during self-paced walking; excessive concurrent rectus femoris-gastrocnemius-tibialis anterior activation during brisk walking; and little-to-no activity in the gastrocnemius, but concurrent rectus femoris- tibialis anterior activation during the 25-foot carry test. In contrast, the O-TTAT gastrocnemius-tibialis anterior concurrently activated (co-contracted) during self-paced and carry tests when the tibialis anterior typically fires, while the rectus femoris activated similarly to the intact limbs and controls in all tests.

DISCUSSION

Despite participant similarities in age, sex, height, weight, and activity levels, differences in residuum physical characteristics and work-related activity performance based on amputation surgical approach were found.

The O-TTAT dyad walked greater distances in timed tests and demonstrated a greater floor-to-knuckle lift capacity, yet carried less weight than the C-TTAT dyad in the 25-foot carry test. More distal RSI weight-bearing load was borne by O-TTAT residua, regardless of activity. Antagonists tibialis anterior and gastrocnemius consistently co-activated at the initiation of swing phase, when the tibialis anterior typically activates during normal gait. There were differences noted in the dyad's contralateral muscle activity. More activity was generated in the intact limb of the C-TTAT dyad group than the O-TTAT intact limb, implying that more work was exerted by the C-TTAT intact limb during WRA performance.

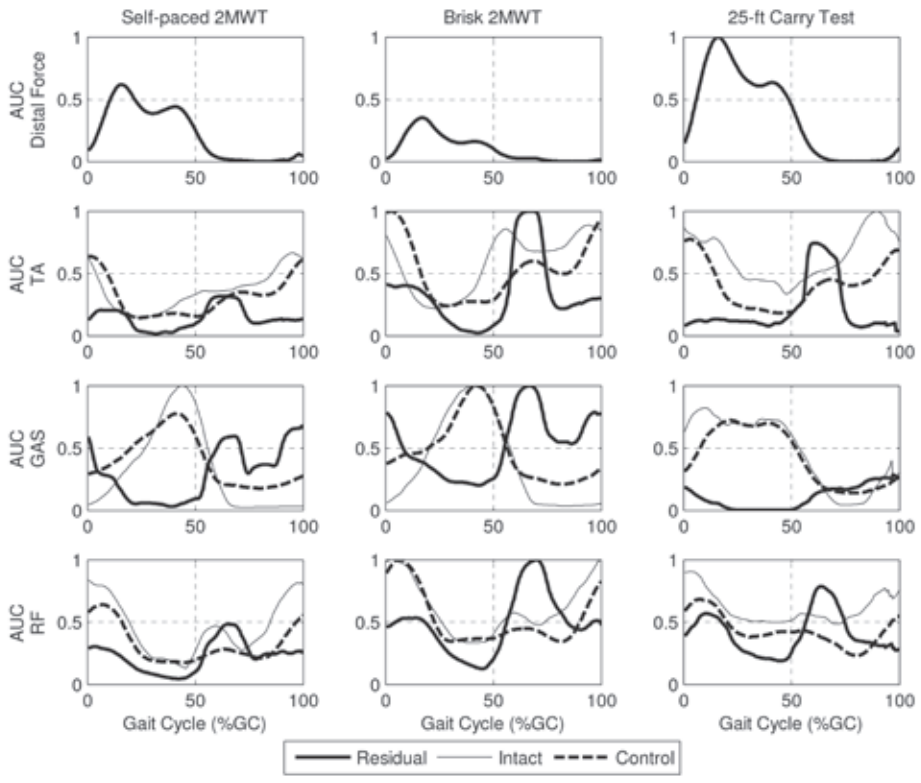
The authors caution that because this study examined a small number of subjects per amputation procedure group (C-TTAT=2, O-TTAT=2), results cannot be generalized to all working-age adults with TTAT. However, this study did illustrate that residuum muscle activity, distal residuum-socket interface load distribution, and intact lower limb activity differed during performance of WRAs in comparable individuals who underwent either conventional or osteomyoplastic amputation. The authors encourage expanded study of performance, RSI load variations, and lower limb muscle activation in individuals with conventional



	TA resid	TA Intact	GAS resid	GAS intact	RF resid	RF intact
CTA	0.3388	0.5813	0.5217	0.3895	0.4849	0.6111
OTA	0.784	0.4126	0.4887	0.3811	0.5706	0.4804
Control	0.5162	0.5162	0.4842	0.4842	0.5261	0.5261

Abbreviations: AUC, area under the curve (*mV-sec*); Self, self-paced 2-Minute Walk Test; Brisk, Brisk 2-Minute Walk Test; Carry, 25-ft Carry Test; TA, tibialis anterior; GAS, gastrocnemius; RF, rectus femoris; C-TTAT, conventional transtibial amputation; O-TTAT, osteomyoplastic transtibial amputation; Control, non-amputee[10]

Figure 5. Muscle activity during brisk 2-Minute Walk Test.



Abbreviations: 2MWT, 2-Minute Walk Test; Self, Self-paced 2-Minute Walk Test; Brisk, Brisk 2-Minute Walk Test; Carry, 25-ft Carry Test; TTA, traditional (conventional) transtibial amputation; OTA, osteomyoplastic transtibial amputation; TA, tibialis anterior; GAS, gastrocnemius; RF, rectus femoris; resid, residual limb; Intact, amputee intact limb; AUC, area under the curve; Control, non-amputee[10]

Figure 6. Residuum-socket interfacial load and muscle activity during the gait cycle of the 2 Minute Self-paced Walk Test, 2-Minute Brisk Walk Test, 25-foot Carry Test for Dyad with Conventional Transtibial Amputation.

and osteomyoplastic surgical approaches as described in this preliminary study, so that these mechanisms can be studied with rigorous scrutiny.

CLINICAL APPLICATION

This preliminary work illustrated differences in perceived function, residual limb volume, and work activity performance in similar, healthy men with unilateral conventional or osteomyoplastic transtibial amputation. Patients with conventional transtibial amputation usually cannot tolerate, and thus, avoid axial end bearing. As a matter of fact, conventional prosthetic socket alignment places the knee joint in 5° of flexion to allow variable weight-tolerate areas and weight-relieving areas on the residuum.[7] Furthermore, distal-most residuum muscle contraction is typically not evident or integral to their plan of care.

In contrast, subjects with osteomyoplastic amputation demonstrated characteristically greater distal-most residuum muscle activity and residuum-socket load distributions during work-related task performance. End bearing and muscle contraction in the residuum were readily tolerated (NPRS = 0). This would imply that therapists should expect and encourage natural axial weight bearing in the residuum during postsurgical and post-prosthetic training. Prosthetic socket alignment may also need to be altered to allow axial weight bearing. Timing and presence of muscle firing appears to be inherently different during prosthetic gait and other functional activities. Therapists may need to re-direct focus to those muscle groups during strengthening and gait training activities. Physical therapy intervention may need to differ based on surgical approach.[10,17] In contrast to the rehabilitation approach with conventional amputation, physical therapists should encourage progressive axially-directed end-bearing, as well as distal-most muscle contraction in the osteomyoplastic residual limb during postoperative rehabilitation.

ACKNOWLEDGEMENT

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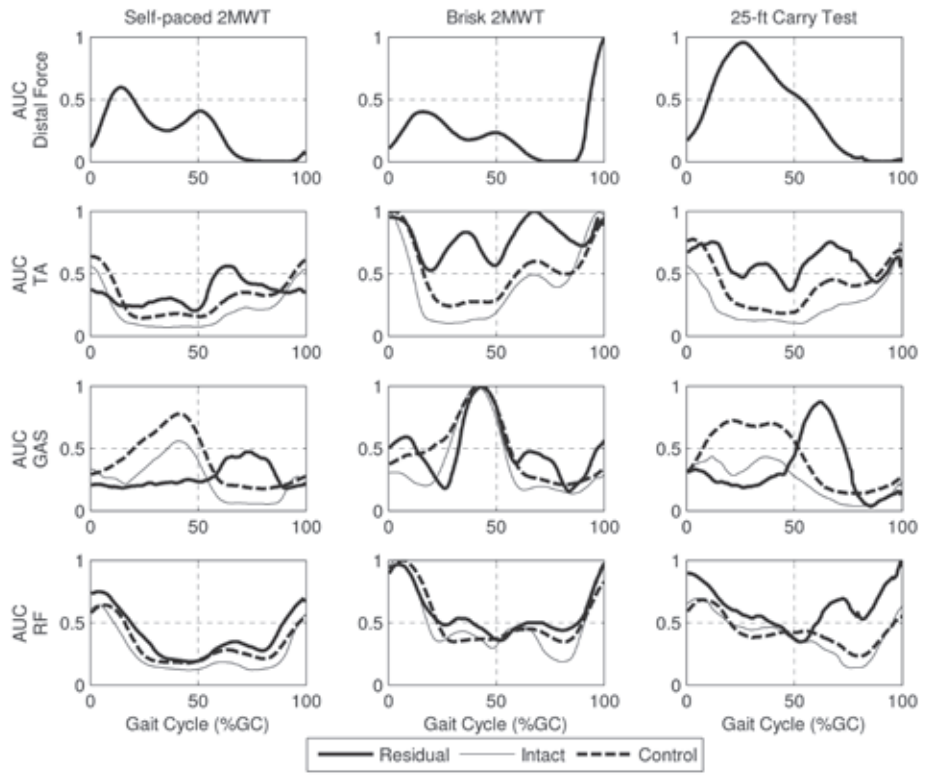

Abbreviations: 2MWT, 2-Minute Walk Test; Self, self-paced 2-Minute Walk Test; Brisk, Brisk 2-Minute Walk Test; Carry, 25-ft Carry Test; TTA, Traditional (conventional) transtibial amputation; OTA, osteomyoplastic transtibial amputation; TA, tibialis anterior; GAS, gastrocnemius; RF, rectus femoris; resid, residual limb; Intact, amputee intact limb; AUC, area under the curve; Control, non-amputee[10]

Figure 7. Residuum-socket interfacial load and muscle activity during the gait cycle of the 2 Minute Self-paced Walk Test, 2-Minute Brisk Walk Test, 25-foot Carry Test for Dyad with Osteomyoplastic Transtibial Amputation.

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Effects of Joint Mobilization and Treatment Timing on the Glenohumeral Joint: A Pilot Study

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ABSTRACT

Background & Purpose: To determine if timing of glenohumeral joint mobilizations during treatment sessions has an effect on range of motion and functional outcomes. Joint mobilization is a commonly implemented treatment by physical therapists to increase active and passive range of motion and function. The role that timing of mobilization during treatment plays on range of motion and function, however, is unknown. **Methods:** A convenience sample of 8 subjects who were under the care of licensed physical therapists were recruited and randomly assigned to either an early or late mobilization group. Active and passive range of motion measurements and a subjective functional questionnaire were taken at initial visit, 1-week, and 4-week follow-up. **Findings:** Mann-Whitney U found no statistically significant results. However, the late mobilization group demonstrated a trend toward greater median change for functional outcome measure. **Clinical Relevance & Conclusion:** Timing of joint mobilization did not produce a statistically significant difference in range of motion gains or functional scores. However, individuals receiving mobilization at the end of their treatment appeared to demonstrate a trend toward greater improvements in functional outcome scores. Further research needs to be conducted to confirm this trend.

Key Words: manual therapy, range of motion, function, shoulder

INTRODUCTION

Shoulder pain is a common medical ailment and economic problem that affects 6.9% to 26% of the population at any given time, and can affect up to 66.7% of individuals over a lifetime.[1] Shoulder pain is ranked second only to back pain when looking at the prevalence of musculoskeletal conditions.[2] The importance of devising an efficient and effective treatment plan is crucial in reducing the resultant burdens placed on the individual. Multiple shoulder pathoanatomical dysfunctions can contribute to various types of impairments. These impairments include pain, decreased range of motion (ROM), poor posture, and weakness. All of these conditions can lead to an altered lifestyle. An individual may be limited with reaching overhead, lifting objects, or participating in community and work activities. Because of these limitations, multiple treatment approaches have been devised, ranging from surgical intervention, steroid injection, medication, and physical therapy. Within the realm of physical therapy, a wide variety of interventions can be administered to address the aforementioned impairments, one of which is joint mobilization.[3,4]

The *Guide to Physical Therapist Practice* defines joint mobilization as "a manual therapy technique comprising a continuum of skilled passive movements to the joints or related soft tissues (or both) that are applied at varying speeds and amplitudes, including a small amplitude/high-velocity therapeutic movement."[5] Using manual therapy to mobilize a joint is a skilled technique widely used by therapists today. These mobilizations can be used to treat a number of pathologies and may be applied to any joint throughout the human body. The supposition behind joint mobilization is increased joint mobility, decreased pain, and improved overall function.[6,7] This has been confirmed through a number of studies that have found joint mobilizations to increase ROM,[8,9] increase strength of surrounding muscular tissues,[10] decrease pain,[8,10-14] and improve overall function.[8,10]

Despite favorable evidence regarding joint mobilizations for improving function, there are no standard recommendations regarding which specific joint, type of mobilization, and more importantly, the timing of this manual therapy technique during the treatment session provides the greatest level of improvement.

A recent case series recommended guidelines regarding which exercises and manual therapy techniques can be applied for subacromial impingement syndrome.[2] Researchers found that along with strengthening, joint mobilization to the glenohumeral, scapulothoracic and thoracic joints lead to improvement in function and an overall decrease in symptoms in patients with subacromial impingement syndrome.[2] When treating adhesive capsulitis, clinical practice guidelines recommended joint mobilizations based off of weak evidence to help decrease pain and improve range of motion.[15] In a systematic review, researchers found that although regularly performed, there was not enough high quality evidence to make specific recommendations regarding the effectiveness of joint mobilizations in shoulder pathology.[3] In a recent randomized controlled trial, it was found that conservative treatment combined with manual therapy leads to an improvement in ROM and function along with a decrease in pain in individuals with subacromial impingement syndrome.[8] Finally, in a series of two kinematic studies, it was determined that individuals with shoulder impingement demonstrated increased glenohumeral superior translation, decreased scapular upward rotation, and increased sternoclavicular posterior rotation during arm elevation as compared to asymptomatic individuals.[16,17] These differences further support the use of joint mobilizations as an intervention for individuals with shoulder pain. In each of the cited research, there have been multiple techniques examined and all have shown varying degrees of effectiveness.

One variable that has yet to be examined is the effect that timing of joint mobilizations may have on improvement in ROM, pain, and function. Anecdotal evidence based upon the Physical Stress Theory[18] suggests that if one actively uses a newly gained ROM after mobilization, that patient would maintain greater gains than those who do not continue to stress the newly lengthened tissues.

It was hypothesized that those individuals who received joint mobilizations early in the treatment session would demonstrate

greater long-term ROM improvements as compared to those individuals who received the same treatment at the end of their session. Therefore, the purpose of this pilot study was to investigate the effect of early versus late joint mobilization on improving shoulder ROM in patients with shoulder pathology. Additionally, a secondary outcome for this study was self-reported functional limitation.

METHODS

Design

A prospective, multiple session, repeated measures between subjects design using patients with shoulder pain in an outpatient physical therapy setting.

PARTICIPANTS

The data was collected and participants were recruited by physical therapists (PTs) who were a part of a St. Luke's University Health Network. A total of 10 data collectors aided in data collection, including the authors of this paper. Selection criteria for PTs were as follows: (1) PTs licensed in the state of Pennsylvania, and (2) currently employed by St. Luke's Physical Therapy. Data collectors ranged in years of clinical practice from one to 19 and included 3 current orthopaedic physical therapy residents, one board-certified sports clinical specialist, 5 board-certified orthopaedic clinical specialists, and one fellow of the American Academy of Orthopaedic Physical Therapists.

A convenience sample of consecutive patients presenting for PT consultation with a chief complaint of shoulder problems was recruited from the outpatient physical therapy clinics of St. Luke's Physical Therapy from March 2014 to September 2014. For inclusion and exclusion criteria, see Table 1. Subjects that were found to require referral to another medical professional were provided with the appropriate referral and excluded from the study. Also, those individuals whose symptoms did not originate from the shoulder, were less than 18 years of age, and were unable to complete functional questionnaire were excluded from the study.

INSTRUMENTATION

The Focus On Therapeutic Outcomes (FOTO)[19] scale is a computerized adaptive test (CAT) that is administered using an iPad (iPad 2, Apple, Cupertino, CA), and all PTs have access to this survey at the St. Luke's Physical Therapy clinics. A CAT is a form of test that adapts to the examinee's functional ability level using computer technology and measurement theory to increase the efficiency of the exam process. The CAT has been shown to be a valid measure of function for outpatient physical therapy.[19-21] More specifically, CAT has been shown to demonstrate good construct validity and responsiveness for patients with shoulder complaints.[22,23]

Each participant underwent a physical examination performed by a licensed PT. During this examination, an assessment of active and passive shoulder ROM,[24-26] along with joint mobility of the glenohumeral joint, scapulothoracic joint, thoracic spine, and other indicated joints was performed. Goniometry is the most widely used measurement tool for PTs to determine changes in ROM.[25] This type of measurement has demonstrated fair-good reliability with regards to intra- and interrater reliability (interrater Rho= 0.64-0.69, intrarater Rho=0.53-0.65).[24,27,28] Acceptable intrarater reliability has been found for both standing and supine abduction and external rotation ROM, and supine passive abduction, flexion, and external rotation ROM.[29] Shoulder active ROM was assessed using standard goniometric positioning for shoulder flexion and abduction.[30] Composite internal rotation was performed by having the patient reach behind his back and determine the thumb position on the vertebrae.[31-33] Composite shoulder external rotation was performed by the individual reaching over his head and as far down on the spine as able and then the 3rd digit position on the vertebra was recorded.[34] These methods of assessing active ROM have demonstrated acceptable reliability for all of the aforementioned conditions. Shoulder flexion and functional internal rotation have good intraclass coefficient (ICC) scores (intrarater ICC = 0.62, interrater ICC = 0.65, intrarater ICC = 0.91, interrater ICC = 0.80), respectively. Shoulder composite external rotation has a moderate kappa score (κ = .73). Shoulder abduction and external and internal rotation demonstrated low ICC scores (intrarater ICC = 0.35, interrater not tested; intrarater ICC = 0.43, interrater ICC = 0.11; intrarater ICC = 0.32, interrater ICC = 0.06), respectively.[32,34] Passive ROM was assessed in supine positioning for shoulder flexion, abduction, and internal and external rotation as described by Norkin and White.[30] Internal and external rotation was measured with the arm elevated to 90° of abduction. These methods of measurement have demonstrated good reliability with the intra-examiner ICC values = 0.98, and inter-examiner ICC values that range from 0.87 to 0.89 for shoulder flexion.[26]

PROCEDURES

Physical therapists from 18 St. Luke's Physical Therapy clinics were recruited to collect data from an interoffice memo and through personal discussion with the investigators. Those who agreed to collect data were educated on data collection methods, provided with data collection tools, and the primary investigator maintained regular contact with the data collectors monthly. Interrater reliability of examiners was established prior to commencement of the study

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
≥ 18 years of age	< 18 years of age
20° side to side range of motion difference	Pain or symptoms distal to the elbow
Diagnosis of shoulder pathology	Acute upper extremity fracture
	Glenohumeral joint hypermobility
	PMH of hemiparesis or peripheral nerve injury affecting the upper extremity
	Active/passive cervical range of motion reproduces shoulder pain
	Positive Spurling's test
	Not fluent in English
	Unable to complete Focus on Therapeutic Outcomes (FOTO)

The above table indicates the inclusion and exclusion criteria that were used in the present study.

and found to be within the range of published studies of measurement of shoulder ROM.[24,27,28,31-34] Convenience sampling was used to recruit subjects for this pilot study.

Initial Visit

As a patient at one of the selected outpatient clinics and upon presentation to the initial evaluation for shoulder pathology, the subject was told, "We are currently doing a study to look at when in the session it is best to perform joint mobilizations. No changes to the content of your therapy will be made regardless of participation in this study. Would you be willing to participate?" If the patient declined, the request was logged. If he agreed, the subject was provided with the informed consent form by the primary PT and consent was obtained. The informed consent form was approved by St. Luke's University Health Network's Institutional Review Board prior to initiation of this pilot study. The participant then took the FOTO questionnaire to establish a baseline subjective score. This score was then recorded for later analysis. The FOTO was used to establish demographic values of number of co-morbidities, age, and gender. The primary PT then selected the next research packet that included participate number and assigned group of intervention (Figure 1).

The primary PT then completed the history and screening exam to determine inclusion or exclusion of the subject. Subjects were excluded if they met any of the exclusion criteria in Table 1, which is similar to other studies investigating patients with shoulder pain.[2] Examination findings were then recorded and if he met all inclusion criteria and demonstrated none of the exclusion criteria, the participant continued in the study.

Next, pain patterns were determined and discussed. First, the "at rest" level of pain was established, and then the "at worst" level of pain using the Visual Pain Rating Scale. Pain patterns over the past week were also investigated. Then, a physical therapy examination continued, ensuring that baseline shoulder ROM measurements were obtained. Specifically, shoulder active ROM was assessed using a standard goniometer in a standing position for shoulder flexion (sagittal plane), and abduction (frontal plane).[24] Composite internal rotation of the shoulder complex was assessed by reaching the thumb behind the back and recording the highest spinous process level reached.[25,26] Composite external rotation of the shoulder complex was assessed by reaching over the head and recording the lowest spinous process level reached.

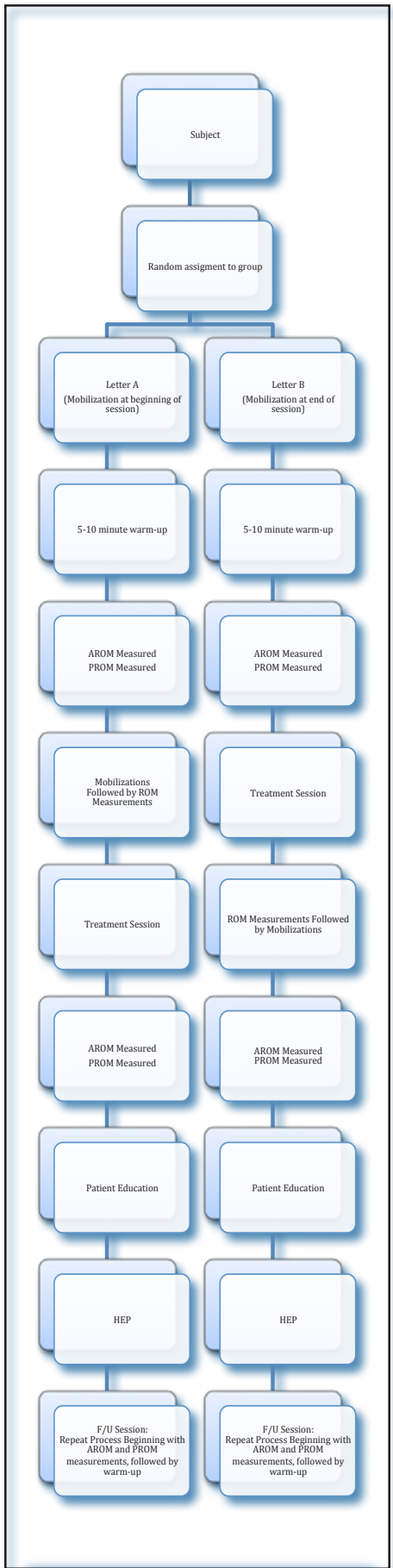

Figure 1. Subject recruitment, flow of initial and follow-up visits.

Passive ROM was measured with a standard goniometer in a supine position, using the methods described by Norkin and White[31] for shoulder flexion (sagittal plane), abduction (frontal plane), and glenohumeral internal and external rotation with shoulder elevated to 90° of abduction. The primary measurements included passive shoulder abduction and external rotation. All other measurements were assessed at initial examination and then at the termination of the study at the 4-week follow-up. After establishing a baseline ROM assessment, the therapist assessed joint mobility of the glenohumeral joint, and associated regions as indicated by the treating therapist. Then, the therapist used her professional judgment to determine which joint mobilization techniques were appropriate for the patient at that time. Those mobilizations may have included inferior, anterior and/or posterior glenohumeral joint mobilizations, posterior-to-anterior thoracic glides or thoracic thrust techniques, posterior-anterior glides, side glides, upper cervical mobilization, and thrust mobilizations for the cervical spine. This is considered a standard of practice and the quality of care was not affected. After initial assessment, the patient was then seen in the clinic for a reassessment of the outcome measurements at week 1 and week 4. On subsequent sessions, the same protocol was followed as the follow-up visits (below), but repeated measurements were not performed.

Follow-up Visits

Follow-up measurements were recorded at 1-week and 4-week time intervals. Follow-up consisted of subjects initially completing the FOTO. The session then began with an active warm up, which consisted of either use of pulleys or an upper body ergometer. After cessation of the active warm-up, depending on the group they were assigned to, joint mobilizations were performed immediately, or at the end of the treatment session. The treatment session consisted of therapeutic and neuromuscular re-education exercises that the authorizing therapist felt appropriate based off of the initial assessment (see Figure 1).

In order for subjects to be eligible for follow-up assessment at 1 week, they were required to have been through a minimum of two treatment sessions within that week. In order for subjects to be eligible for follow up assessment at 4 weeks, they needed to

have participated in a minimum of 6 treatment sessions within those 4 weeks.

If subjects failed to meet the minimum treatment session requirement, they were removed from the study and all subsequent statistical analyses. All data was recorded on a computerized spreadsheet on a secure, password-protected server. All patient information was de-identified.

RESULTS

A total of 31 individuals were screened to participate in the study. Of the 31 screened, 8 individuals met the inclusion criteria and were included in the study (4 males, 4 females, age range 40-89, median age = 64 years) and were randomly assigned to a group. A total of 23 individuals were excluded from the study—3 for having symptoms distal to the elbow, 1 for having an acute upper extremity fracture, 1 secondary cervical motion reproducing shoulder pain, 2 for not being fluent in English, 8 for having acute shoulder surgery, and 8 for having less than a 20° ROM difference between the affected and non-affected side in flexion, abduction, or external rotation.

Both the early mobilization and late mobilization treatment groups had 4 subjects, demographic differences between groups can be seen in Table 2. Each group contained two males and two females, the early mobilization group had a median age of 68 years and the late mobilization group had a median age of 61 years. The acuity of symptoms for each group can be found in Table 3. The early mobilization group had a median fear avoidance score of 18.5 compared to 6.5 of the late mobilization group. When comparing the early mobilization group to the late mobilization group, the median body mass indexes (BMI) were 39.6 and 29.2 respectively. Each group had one subject that chose not to disclose information needed to calculate BMI. The early mobilization group reported a median of 5 co-morbidities on FOTO compared to a median of 5.5 co-morbidities for the late mobilization group.

To test the hypothesis, a Mann-Whitney U test was used to analyze ROM and functional outcomes secondary to having non-parametric data and a small sample size (Table 4). Between groups, there was no statistical significance for active flexion, abduction, internal rotation, or external rotation ($p = .05$, critical value = 1). Furthermore, there was no statistical significance between groups in passive flexion, abduction, or external rotation ranges of motion ($p = .05$, critical value = 1). Median active and passive range of motion scores for the early and late mobilization groups can be found in Table 5. The late mobilization group had greater 4-week functional outcome gains (23 points, range 8-30 points) compared to the early mobilization group (14 points, 9-28 points). Each individual in either group did demonstrate at least an 8-point functional score change. However, these changes were not found to be statistically significant.

Table 2. Patient Demographics

	A	B
Subjects (n)	4	4
Males	2	2
Females	2	2
Median age (range)	68 (54-89)	61 (40-72)

Above demonstrated the demographic break down between the two different groups, A=early mobilization, B=late mobilization.

Table 3. Symptom Acuity

Group	8-14 days	22-90 days	91 days-6 months
A	2 subjects	2 subjects	0 subjects
B	1 subject	1 subject	2 subjects

Above demonstrates the symptom acuity between group A=early mobilization and group B=late mobilization group.

DISCUSSION

This is the first study to directly compare the effects of joint mobilization treatment timing to changes in ROM and self-reported functional outcomes. Anecdotal evidence based upon the Physical Stress Theory[18] suggests that if one actively uses a newly gained ROM after mobilization, that patient would maintain greater gains than those who did not continue to stress the newly lengthened tissues. Considering this evidence, we hypothesized that individuals receiving joint mobilization early in the treatment session would demonstrate better long-term ROM improvements as compared to individuals who received the same treatment at the end of their session.

The present study results demonstrate an early trend toward contradicting our hypothesis since there were no statistically significant changes between groups in regard to ROM at the 1-week and 4-week follow-up. There were also no statistically significant changes between groups in regard to self-reported functional status (FOTO) at the 1-week and 4-week follow-up.

However, there appeared to be an early trend towards significance for the late mobilization group in regard to ROM. This trend can potentially be explained by the amount of warm-up time. In this study, we used a 10-minute warm-up as the standard. To our knowledge, there is no current evidence looking at warm-up time and its effect on joint mobilization, which presents an idea for future research. Those individuals in the late mobilization group may have received more adequate tissue warm-up prior to the joint mobilizations. The increased tissue extensibility allowed for greater ROM gains both during and between sessions, which would potentially explain the trend that was found. The late mobilization group was able to complete a 10-minute warm-up, followed by a full therapeutic exercise regimen.

The difference in warm-up time may also help explain the change in functional outcome that was observed. Those individuals in the late mobilization group had a trend toward greater gains in ROM directly at the end of the session, leading to an overall greater perceived functional improvement immediately following each session. This trend will be explained in more detail later in this discussion. Future researchers should consider using a longer length of warm-up. An active warm-up of 10 to 15 minutes may be most appropriate to improve tissue extensibility.[35]

As previously mentioned, another trend that the findings of our current study

Table 4. Mann-Whitney U Data

Active flexion	U1	U2
IE A vs B	9	7
IE vs Pre mobs	12.5	15.5
Pre vs Post 1st time; A	9	12
Pre vs Post 1st time; B	2	14
Pre vs Post 2nd time, A	7	9
Pre vs Post 2nd time, B	6	10
IE vs final	5.5	10.5
Active Abduction		
	U1	U2
IE A vs B	21	15
IE vs Pre mobs	21	15
Pre vs Post 1st time; A	20.5	15.5
Pre vs Post 1st time; B	21.5	14.5
Pre vs Post 2nd time, A	18.5	17.5
Pre vs Post 2nd time, B	19.5	16.5
IE vs final	8	8
Passive Flexion		
	U1	U2
IE A vs B	12.5	7.5
IE vs Pre mobs	8	8
Pre vs Post 1st time; A	5.5	10.5
Pre vs Post 1st time; B	5	11
Pre vs Post 2nd time, A	6.5	9.5
Pre vs Post 2nd time, B	4.5	11.5
IE vs final	5	11
Passive Abduction		
	U1	U2
IE A vs B	8	8
IE vs Pre mobs	5	11
Pre vs Post 1st time; A	5.5	10.5
Pre vs Post 1st time; B	5	11
Pre vs Post 2nd time, A	7	9
Pre vs Post 2nd time, B	6.5	9.5
IE vs final	6	10
Passive ER		
	U1	U2
IE A vs B	11	5
IE vs Pre mobs	7	9
Pre vs Post 1st time; A	7.5	8.5
Pre vs Post 1st time; B	13	3
Pre vs Post 2nd time, A	5.5	10.5
Pre vs Post 2nd time, B	6	10
IE vs final	2	14

Above are the U values found between the varying groups. IE means initial evaluation, ER means external rotation, A means early mobilization group, and B means late mobilization group. All values had a critical value of 1 to achieve statistical significance.

revealed is that late mobilization has a greater impact on self-reported functional outcome (FOTO) gains compared to early mobilization at a 4-week follow-up (increase of 23, increase of 14, respectively). The mean difference between groups demonstrated a 9-point improvement in the later mobilization group over the early mobilization group. While the between group differences did not reach statistical significance, the very small sample size of this pilot study results in a critical value that is extremely challenging to attain in the comparison of two clinically accepted interventions. The underlying challenge for future studies is to determine whether or not this seemingly large numerical change is larger than that of the overall population resulting in a clinically significant difference, or if the change is actually smaller, resulting in no significant difference.

Due to variability of subject-specific impairments, it was decided that there would not be specific joint mobilizations that each participant was to receive. This decision was made due to current practice standard, as each patient is evaluated individually. Data collectors were instructed to provide intervention to each patient based upon that patient's specific impairments. There are both pros and cons to this decision. First, the fact that no standardization was given in regard to mobilization technique could be considered a positive as it allowed for each subject to receive the mobilization procedures specific to his or her needs, theoretically allowing for the most improvement possible. In turn, the result would have provided more generalizability to other patients with shoulder pain.

At the same time, the decision to use non-standardized mobilization techniques may have prevented us from finding a statistically significant effect. Some subjects may have received only glenohumeral mobilization, some may have only received thoracic mobilization, and some may have received a combination. Therefore, our results may have been different depending on which mobilization techniques were being used. Tate et al[2] performed a case series where they standardized which specific joints should be targeted when performing joint mobilizations. In a systematic review, 6 studies that met the inclusion criteria combined joint mobilizations with therapeutic exercises. All of the studies but one did not have a standardization of joint mobilizations; they were simply applied to the glenohumeral joint.[3] A majority of the studies looking at efficiency

Table 5. Range of Motion Data

		IE	1 week pre-mobilization	1 week post-mobilization	4 week pre-mobilization	4 week post-mobilization
Active Flexion	Group A	138.5°	150°	165°	156.5°	150°
	Group B	135°	152.5°	159°	155°	156.5°
Active Abduction	Group A	107.5°	122.5°	140°	142.5°	147.5°
	Group B	132.5°	145°	153.5°	160°	168.5°
Active IR†	Group A	N/A	0.5	0.5	2	1
	Group B	N/A	-0.5	0	0.5	1.5
Active ER†	Group A	N/A	0.5	0	0	0
	Group B	N/A	-0.5	0	0	0.5
Passive Flexion	Group A	150°	167.5°	172.5°	165°	167.5°
	Group B	140°	160°	165°	156.5°	162.5°
Passive Abduction	Group A	137.5°	150°	167.5°	165°	170°
	Group B	160°	147°	156°	165°°	170.5°
Passive ER	Group A	80°	90°	90°	75°	77.5°
	Group B	60°	75°	81°	86.5°	89°

The above table provides the median range of motion in degrees or spinal segment level (†) change. Group A is the early mobilization group. Group B is the late mobilization group.
Abbreviations: IE, initial evaluation; IR, internal rotation; ER, external rotation.

of joint mobilizations in adhesive capsulitis had varying protocols, with no specific joint mobilizations.[4] In the end, the majority of the research literature has looked at the effect that mobilizations play on the glenohumeral joint only. Therefore, that is why we suggest choosing specific joints that mobilizations should be applied to during this study.

Another possibility for the lack of statistically significant findings is the time of follow-up. The length of follow-up was 1 week and 4 weeks from the initial evaluation. It is possible that the 4-week follow-up time frame was too short to show significance within or between groups. In this case, a question of concern is brought forth, as to whether a 12-week (3-month) follow-up should be added, or discharge from skilled physical therapy be considered as a more appropriate final follow-up. It should be considered that even though a 4-week follow-up was chosen, this time frame may not have been significant enough to show a true change in ROM or self-reported functional outcome. By extending the length of the follow-up or until the patient is discharged from care, investigators may have greater ability to discover the possibility of statistical significance. Therefore, we are recommending that future researchers heavily consider a longer follow-up time frame.

A total of 10 clinicians volunteered to collect data for the study over a 6-month time frame. However, only 6 of the volunteers were able to either collect data for the study or exclude subjects. For future studies, the length of the data collection period should be increased to allow for the possibility of a larger sample size. Secondary to investigators finding a 40% change in median functional scores between the two groups, it is recommended that future investigators use a sample size of 32 subjects to show adequate power and statistical significance ($\alpha = 0.05$, $\beta = 0.8$, SD = 1.4). For this pilot study, a total of 8 subjects were included over a 6-month time frame. As a result, the total length of future studies may need to be 24 months to recruit the proper number of subjects. Also, improving the incentives for data collectors or subjects (as there were none) may be considered, thus generating more interest.

Considering our exclusion criterion and its effect on the elimination of subjects, a total of 8 subjects were eliminated secondary to acute shoulder surgery. For future studies, researchers should consider including joint mobilizations for individuals recently undergoing shoulder surgery between 6 to 12 weeks postoperatively. The main concern while performing joint mobilizations following a surgical intervention is disrupting the surgical procedure/fixation. According to Muraki et al,[36] glenohumeral distraction, anterior translation, and posterior translation glides had no significant alteration onto the stresses placed on a repaired supraspinatus tendon. However, clinicians need to take into account the specific patient postoperative guidelines and continue to adhere to the limitations set forth by those postoperative guidelines. Thus, inclusion of appropriate patients who underwent a surgical procedure would likely increase the number of subjects included in future studies.

However, researchers would need to consider a multitude of factors before including postsurgical subjects in the study. As previously mentioned, patient-specific postoperative guidelines need to be considered to ensure that joint mobilizations are safe at the selected time frame in the rehabilitative process. Furthermore, it may be difficult to truly assess the change joint mobilizations had on ROM or function following a surgical procedure. It is the authors' opinion based off of clinical experience that ROM and functional gains are more of a result of acute tissue healing than timing of interventions within a single treatment session as patients progressed through postoperative rehabilitation. Because of this, it may be difficult to determine what gains were made secondary to joint mobilizations versus tissue healing following surgery.

A total of 8 subjects were excluded from the study secondary to not having a 20° ROM difference side-to-side. Tate et al[2] demonstrated that a total difference of 10° is adequate enough to demonstrate a ROM difference from side-to-side. For the purpose of this study, we attempted to capture individuals with larger ROM differences to demonstrate a significant change in ROM. However, future researchers should consider changing inclusion criteria from a 20° ROM difference to a 10° ROM difference to capture more individuals for the study that would benefit from joint mobilizations.

When comparing acuity of symptoms, co-morbidities, fear, and BMI between groups, the late mobilization group appeared to have symptoms of a longer duration, relatively the same amount of co-morbidities as the early mobilization group, lower fear-avoidance scores, and lower BMI scores compared to the early mobilization group. The median range of symptoms for the early mobilization group was 15 to 52 days compared to 56.5 to 135 days for the late mobilization group. Because there were no statistical differences between groups, acuity of symptoms may not have played a role related to ROM changes. However, the trend towards greater functional outcomes with the late mobilization group compared to the early mobilization may be related to chronicity of symptoms. It is the authors' opinion that individuals with a longer duration of symptoms may have reported greater increases in function secondary to returning to activities they have been unable to participate in for a longer period of time. This factor may have contributed to patients perceived levels of improvement, regardless of tissue histological factors.

When analyzing the effect fear has on individuals and their functional outcomes, Leeuw et al[37] demonstrated when fear of pain and other psychological factors are not perseverated on by patients, clinicians should expect a normal recovery. However, when elevated fear levels are present, avoidance behaviors may occur, which could result in decreased functional levels secondary to pain.[37] Because of this, the lower fear avoidance scores of the late mobilization group may have contributed to increased levels of function as demonstrated on FOTO.

According to the World Health Organization Body Mass Index classification, individuals from the late mobilization group were classified as overweight whereas the early mobilization group was classified as morbidly obese. It should be noted though that one individual from each group chose not to disclose information needed to calculate their BMI. However, Racette el al[38] has discussed that obesity is related to a decreased aerobic capacity that also is likely to decrease function in patients. Although our subjects were randomly assigned to groups, the differences in obesity classification between groups may have contributed to the greater functional outcomes for the late mobilization group.

LIMITATIONS

There are several limitations to this study. First, as this was a pilot study, the sample size was intentionally small (8 subjects). All subjects were older than the average age of the general population of patients presenting to physical therapy for orthopaedic diagnoses in the same health system. As such, the generalizability of the findings may be questioned.

Second, a large exclusion criterion had a significant effect on reducing the size of the sample. A total of 23 subjects were eliminated from the study prior to initial measurements for having met at least one of the exclusion criteria. Third, the joint mobilization techniques used in this study were not standardized. However, despite the amount of evidence regarding joint mobilizations for improving function, there are no standard recommendations regarding which specific type of mobilization should be used. Because of this, individuals received mobilizations based upon clinician judgment to improve current impairments. Fourth, the subjects included in this study were selected based upon a sample of convenience.

Based on the size and exclusivity of the sample, and the limited conclusions regarding timing of joint mobilization and its effect on ROM and self-reported function, further investigation of the methods is required using larger and more diverse populations.

CONCLUSION

This pilot study did not demonstrate that timing of mobilization has a statistically significant difference in the improvement of active or passive ROM. However, the group of subjects who received mobilizations at the end of their treatment session did demonstrate a trend towards improved self-reported functional status compared to those who received mobilizations early in their treatment session. Future studies should consider including a greater number of subjects, involving subjects that have a ROM difference of 10° compared to 20°, and limit joint mobilizations only to the glenohumeral joint in order to determine if there is a difference in mobility and function based upon intra-session timing of mobilizations. In addition, consideration should be given to the limitations that existed within this study, attempting to minimize them in order for the findings to be applicable to the general population across the lifespan.

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Paradoxical Vocal Fold Motion—Importance of Proper Diagnosis and Clinical Communication: A Case Report

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ABSTRACT

Purpose: To illustrate the importance of proper diagnosis, and clinical communication for people dealing with the difficult diagnosis of paradoxical vocal fold motion (PVFM). **Method:** In this case report, the authors hope to review PVFM causes and differential diagnosis and discuss the clinical treatment methods. **Results:** The patient had significant complaints with regards to throat tightening and difficulty breathing, and was misdiagnosed with anaphylaxis and temporomandibular disorder. She was seen by a physical therapist who suspected a condition other than what was diagnosed and suggested an evaluation by a speech language pathologist. After a thorough history and examination, the patient was diagnosed with PVFM disorder. Though having this condition for over a year, her complaints were resolved after 4 sessions of care and she returned to normal functioning. A 12-month follow-up revealed the patient without complaints. **Conclusion:** Paradoxical vocal fold motion is often difficult to properly diagnose. Having close and clear communication between colleagues in the rehabilitation setting is vital for proper diagnosis and treatment of uncommon and challenging medical conditions. An interdisciplinary approach will likely lead to better patient outcomes with conditions such as PVFM.

Key Words: stridor, vocal cord dysfunction, speech therapy, physical therapy

INTRODUCTION

Diagnosis is defined as "the use of scientific and skillful methods to establish the cause and nature of a sick person's disease. The value of establishing a diagnosis is to provide a logical basis for treatment and prognosis."[1] Unfortunately, often the source of a person's complaints cannot be established with complete certainty. It is estimated that upwards of 110,000 malpractice claims are filed each year in the United States[2] due to misdiagnosis or failure to diagnose. The causes of these errors can be due to the condition being rare, with symptoms being suggestive of many other conditions, or the patient having a rare presentation.[3] Adding to the confusion is that many conditions have co-morbidities,[4] thus clouding the ability to accurately understand the full extent of a person's medical condition. A patient suffering from any medical condition will seek treatment in an effort to resolve the difficulties associated with the illness. The primary care physician (PCP) is often the first stop along the medical management process. After initial consultation, if the medical issue is out of the knowledge base of the PCP, a referral to a specialist is made.[5] If the subsequent examination is inconclusive, or an incorrect diagnosis is made, the patient may receive improper treatments[6] and experience a rising level of frustration. The person begins a cycle of searching for additional opinions in an effort to resolve the symptoms. The case report presented here illustrates one woman's frustrating search for a proper diagnosis, understanding, and treatment of a difficult to diagnose condition[7] known as paradoxical vocal fold motion (PFVM).

Paradoxical vocal fold motion is a medical condition that is defined as inappropriate adduction of the vocal fold, which may combine with incomplete glottal closure causing an obstruction to the airway leading to a host of symptoms, including but not limited to wheezing, chest tightness, throat tightness, change in voice, and stridor.[8] This condition is predominately found in females,[6] with the degree of the condition ranging from mild and intermittent to constant and severe. The patient frequently reports "choking" or "tightness" in the throat making breathing difficult; the episode lasts from a few minutes to hours,[7,9] with the symptoms and physical findings completely resolving at the end of the "attack." Co-morbidities in PVFM episodes have been found to include gastroesophageal reflux disease, asthma, post-nasal drip, and anxiety.[10,11] Patients with this condition are typically misdiagnosed with resultant mistreatment and non-effective medications. Any examination during a period of being asymptomatic will reveal confusing negative findings.[12] One study[13] indicated that in one year, patients with PVFM, before being properly diagnosed, had an average of 9.7 emergency room (ER) visits, and 5.9 hospital admissions. Morris et al[8] noted patients being misdiagnosed for 4.9 years, and an average 6 ER visits yearly. When a diagnosis is unrecognized and untreated, detrimental psychological effects and a reduced prognosis may occur.[14,15]

CASE STUDY

Ms W is a 42-year-old female who reported a long history of "months and months experiencing throat tightening and trouble breathing lasting up to several hours." She had seen multiple physicians and had been given no clear-cut diagnosis. On 5 occasions, she sought care in the ER, each time being discharged after examination, at times with new medications recommended, and advised to seek help through her PCP or other expert clinicians. After her last ER visit, Ms W sought follow-up care with an ear, nose, and throat (ENT) physician, traveling 3 hours for the consultation. On the day of the examination, the patient reported her complaints as, "left ear discomfort, pressure and throat discomfort" (Accessed physicians note, June 23, 2013). She reported to the ENT that 4 months previously, she had a "anaphylactic reaction" due to unknown reasons, and that she was told that her "throat symptoms were possibly secondary to her steroid use after the anaphylaxis." Ms W noted "pain and fullness" in her left preauricular region radiating down into the mandible. The history and examination included the use of flexible laryngoscope that revealed "no masses or abnormality, with normal airway, normal laryngeal mobility, and no lesions." The ENT concluded that the patient exhibited musculoskeletal symptoms and she was referred for physical therapy

care to an urban outpatient orthopaedic clinic with a diagnosis of "TMJ/Myofacial Pain/Spasms of the Throat."

Physical Therapy Examination

Ms W reported pain in her face in the muscles of mastication (primarily on the left) and in the bilateral cervical region with a pain level on a Numeric Pain Rating[16] scale of 8/10 (with 0 being no pain to 10 being maximum pain). She presented with postural deficits of forward head and rounded shoulders. Her active range of motion of her cervical and mandible were within normal limits, with no loss of sensation, strength, or active range of motion of her extremities. "Tenderness" with palpation of her muscle of mastication and suboccipital region was noted. She reported a Neck Disability Index[17] score of 58/100 (with 0 being target value), and a TMD Index[18] score of 23/40 (with 0 being target value). Ms. W's overriding complaints were of "tightness" and "trouble breathing," located in the anterior portion of her throat. She carried an EpiPen with her at all times due to "the anaphylaxis" she was previously diagnosed with on one of her ER visits. Based upon the examination findings and the patient noting that she "grinds and clenches her teeth" on occasion, being brought on by "anxiety over the throat issue," the physical therapist (PT) felt that her TMD and cervical issues were secondary in nature in importance to the anterior throat complaints. After discussing the results of the examination with the patient, a referral to a speech language pathologist (SLP) was suggested. The patient was informed that PT would continue to address the secondary complaints, but due to the insurance requirements and the need for a physician's referral, an appointment for an SLP evaluation would be set once this process was completed. The insurance approval and doctor's prescription took one week to secure, and the SLP evaluation was completed the following week. The time from the PT evaluation to the SLP consultation took 16 days.

Physical Therapy Intervention

During the approval and scheduling process for speech therapy, Ms W received 4 sessions of physical therapy care consisting of treatment to address the TMJ/myofacial concerns of the face and cervical regions, as well as care for her anterior throat complaints prior to evaluation by SLP. The goals of physical therapy intervention were to: (1) decrease cervical and facial pain to a maximum of 3/10, (2) improve posture to a more anatomically correct position, (3) improve activities of daily living as indicated by a Neck Disability Index of 20 or less/100 and a TMD Disability Index of 10 or less/40.

Modalities for symptom control consisted of moist heat[18,19] to the anterior cervical spine, instruction on postural correction, soft tissue suboccipital, and muscles of mastication stretching by the therapist, in clinic exercises, and home exercises.[20] The patient noted overall improvement in her posture, and pain level dropping down to a 1/10, her Neck Disability Index being a 2/100, and her TMD Disability Index scoring a 3/40. Ms W felt that although "my face and back of my neck was much better," overall her anterior throat complaints were "the same."

Results of PT Intervention

Symptom	Initial Evaluation	Final Session
Anterior Throat Tightness	Yes	Yes
Cervical and TMD Pain	8/10	1/10
Neck Disability Index	58/100	2/100
TMD Disability Index	23/40	3/40
Number of Visits	1	4

Speech Therapy Examination

The patient was seen for a speech therapy examination, during which she complained of throat tightening of unknown etiology occurring weekly. Ms W reported anaphylaxis of unknown cause and a feeling of throat tightening during these times. She did not feel this was allergy related. She reported the first episode of voice tightening was one year prior to evaluation. She denied dysphasia. During episodes of vocal tightness, the patient used a steroidal inhaler for relief.

The patient quit smoking 25 years ago. She had a diagnosis of gastroesophageal reflux disease that she controlled with her diet. The patient reported she did not drink alcohol. She limited her caffeinated beverage intake to one cup of coffee per day. Total vocal use was approximately 2 hours daily. She recalled having one episode of vocal tightness after an incident of yelling very loudly.

Behavioral voice assessment revealed mild strained vocal quality and low volume. Use of clavicular breathing was observed. Noninstrumental assessment revealed within functional limit pitch range.

The S/Z ratio, an indicator of laryngeal pathology was used. The voiceless/voiced cognate pair productions tool takes the length of time a person can sustain an "S" sound divided by the length of time a person can sustain a "Z" sound. Normal is considered one second; anything over 1.40 seconds is considered as having possible vocal fold dysfunction.[21] The S/Z ratio was 1 maximum phonation time for Ms W was 4.5 seconds judged across 3 consecutive trials. The norm is 15 to 20 seconds.

Functional Communication Measure of Voice, a series of 7-point rating scale going from Level 1 (least functional) to Level 7 (most functional) designed to describe a patient's functional communication ability, was used at initial evaluation as an outcome measurement. Ms W was determined to fit into a Level 5: Voice occasionally sounds normal with self monitoring, but there is some situational variation. The individual's ability to participate in vocational, avocational, and social activities requiring voice is rarely affected in low vocal demand activities, but is occasionally affected in high-vocal demand activities.[22]

Given the absence of organic findings on the ENT evaluation and the results of the voice evaluation, it was determined that the patient had symptoms consistent with PVFM. The goals of treatment were to focus on retraining normal adductory and abductory movements during phonation and breathing as described in the literature.[6]

Speech Therapy Intervention and Results

Speech therapy "is regarded as the primary therapy and cornerstone of treatment,"[23] for paradoxical vocal cord movement, while Morris & Christopher[8] noted, "speech therapy has been the primary modality used for chronic treatment, and to prevent recurrent symptoms." The patient was seen for voice therapy with a focus on training diaphragmatic breathing techniques, relaxation techniques to facilitate vocal cord abduction, negative practice activities to help facilitate decreased reaction to tightening of the vocal cords, and improved coordination of airflow for speech. In addition, vocal hygiene, including suppression of behaviors such as coughing or throat clearing, was taught.

At the end of 4 sessions of voice therapy, the patient's complaints were resolved with her S/Z ratio being a 1, her Functional Communication Measure for Voice was Level 7, while experiencing no pain in the face, throat, or cervical regions. The patient was able to successfully and independently participate in vocational, avocational, and

social activities requiring high or low vocal demands (for results of the speech therapy care, see table below). Self monitoring was effectively used, but only occasionally needed. Teaching relaxation, airflow, and vocal control allowed the patient to have increased control during vocal tightening episodes. Ms W reported although she still had episodes of "vocal tightening," she was able to immediately relax her vocal cords by implementing the techniques she learned. The patient felt she had the ability to differentiate paradoxical movement of her vocal cords and anaphylaxis. After both a 6- and 12-month follow-up discussion, the patient reported being able to control her episodes of vocal tightening with the techniques she had learned; thus eliminating further ER visits. The patient was more comfortable in controlling her "throat tightening" when she felt it coming on.

Results of Speech Therapy Intervention

Symptom	Initial Evaluation	Final Session
Anterior Throat Tightness	Yes	None
S/Z Ratio	1:1	1:1
Maximum Phonation Time	4.5 seconds	15 seconds
Functional Communication Measure	5	7
Number of Visits	1	4

DISCUSSION

So why is a paper describing speech language pathology care, being published in a physical therapy publication? This case report has significant implications for PTs regardless of practice setting. Both of the authors believe that due to the variety and complexities of the numerous patients seen in the course of daily clinic care, having a pool of experienced professionals to collaborate with is of vital importance. One must know his or her own knowledge-based limitations, and consult another professional when needed. Coupled with the fact that "Face to face patient-provider interaction has become less common across the spectrum of health care, affecting all providers,"[25] a close inter-professional communication is essential for those patients that present with complex conditions. The therapist must not be afraid to question the referral diagnosis, and needs to be properly prepared to defend his professional opinion, based on the facts, to make sure the proper care is given. In the case presented here, the PT knew, based upon the history and presentation of the patient's symptoms, that this was a "rare and confusing" case, outside of his skill set. Having a close association with speech language pathology, and the ENT physician, allowed the PT to properly facilitate further care of Ms W, to an additional professional who could continue to decode the complaints effectively. The SLP, having the ENT and PT rule out other medical issues, could then focus on and properly diagnose and treat the underlying PVFM.

CONCLUSION

The patient, Ms W, had been seeking care with multiple health providers for her major complaint of anterior throat tightness and difficulty breathing and was misdiagnosed with anaphylaxis and temporomandibular disorder. She was seen by a PT who suspected a condition other than what was diagnosed, and suggested an evaluation by a SLP. After a thorough history and examination, the patient was diagnosed with PVFM disorder. Despite having this condition for over a year, her complaints were resolved after 4 sessions of care and she returned to normal functioning. A 12-month follow-up revealed no complaints by the patient. Ms W's feelings on this matter were more succinctly stated this way, "your effort accomplished that in which the many doctors and the medications could not."

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Time for Specialists to Embrace Continued Competency

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The Citizens Advocacy Center made a powerful statement about the importance of continuing competence in their April 2004 report *Road Map to Continuing Competency Assurance*: "Patients have every right to assume that a health care provider's license to practice is the government's assurance of his or her current professional competence, and clinicians themselves would like assurance that those with whom they practice are current and fully competent."[1]

Clinical specialization is the process by which a physical therapist builds on a broad base of professional education and practice to develop a greater depth of knowledge and skills related to a particular area of practice. The American Physical Therapy Association (APTA) House of Delegates approved the concept of specialization in 1976 and established the Task Force on Clinical Specialization, which developed the Essentials for Certification of Advanced Clinical Competence in Physical Therapy. The House of Delegates adopted this document in 1978. The specialist certification program was established to provide formal recognition for physical therapists with advanced clinical knowledge, experience, and skills in a specialty area of practice and to assist consumers and the health care community in identifying these physical therapists. The American Board of Physical Therapy Specialties (ABPTS) was then established to oversee the certification process. As each new specialty area was recognized by the House of Delegates, the ABPTS appointed a specialty council that identified and defined advanced skills, established eligibility criteria, and developed the specialty examination. The mission and vision statement further clarify ABPTS's role in the overall process.

> The American Board of Physical Therapy Specialties oversees the specialist certification process. Their mission is "to advance the profession of physical therapy by establishing, maintaining, and promoting standards of excellence for clinical specialization, and by recognizing the advanced knowledge, skills and experience by physical therapist practitioners through specialist credentialing." The vision of the ABPTS is to "create, promote, and sustain a culture in which the highest quality physical therapy is provided by therapists who attain and maintain certification in a specialty area."[2]

The specialty councils make the determination on the content areas to be covered on the examination and the number of items in each area, based on the results of a practice analysis. This practice analysis, also referred to as a job analysis, is a systematic plan to study professional practice behaviors and knowledge that comprise the practice of the specialist. The practice analysis is described in detail in the *Description of Specialty Practice* (DSP) for each specialty area. The practice analysis is a description, based on survey data and subject matter experts, of the task and roles as well as the expected knowledge, skills, and abilities of physical therapists who possess advanced clinical skills in the area of specialty practice and is performed in each specialty area every 7 to 10 years to account for changes related to specialist practice. The DSP for each specialty area is used to develop the content outline for the corresponding exam. The Specialty Council on Cardiopulmonary Physical Therapy was the first to complete the process, and the cardiopulmonary specialist certification examination was first administered in 1985. Since then, 7 additional specialty areas—Clinical Electrophysiology, Geriatrics, Neurology, Orthopaedic, Pediatrics, Sports, and Women's Health—have been established.

The following is an overview of the evolving recertification processes and a description of the planned modifications for the recertification process.

Recertification

Since the inception of physical therapy clinical specialization in 1978, board certification was not lifelong. To ensure current knowledge and practice skills at a specialist level, recertification has always been required after every 10 years. This recertification standard included demonstrating evidence of ongoing clinical practice in the specialty area by either passing the initial certification examination again, preparing a professional development portfolio (PDP), or providing evidence of completion of an APTA-accredited residency program within the specialty area. However, changes over the past decade in definitions of physical therapist competencies and recognition of weaknesses in the current recertification process have led to the development of a more continuous concept for recertification. Recently, several issues have come to the attention of ABPTS regarding this re-credentialing process:

1. Most specialists (88%) have chosen to re-credential using the PDP option. While this shows ongoing activity in the specialty area, there is little quality control regarding the specific activities listed on the PDP and there is no independent assessment of knowledge in the specialty area.
2. The specialty councils have repeatedly attempted to revise the PDP to improve the quality of data and the representativeness of specialty practice, but in spite of multiple revisions, there continues to be a shared sense among the specialty councils and ABPTS that the PDPs do not capture the essence of specialist practice.
3. As the number of specialists has increased over the past 25 years, the workload required by some specialty councils (eg, Orthopaedics) to review the PDP documents has become overwhelming.
4. A study of re-credentialing of multiple health care professions, conducted by ABPTS in 2002-03, suggested that most certification boards were no longer using a portfolio approach.

These issues resulted in the ABPTS deciding to place a moratorium on PDP changes in 2004 and a decision to proceed with redesigning the re-credentialing process. One strong theme that emerged

from discussions on re-credentialing was to move to a model of continued competency throughout the years of certification rather than a one-time recertification process as the certification period lapses. Adopting a model of continued competency would permit ABPTS to achieve 3 goals identified as being important to the implementation of a new re-credentialing process: (1) reflect successful components of the current process, (2) correct flaws in the current process, and (3) consider and potentially adopt methods that are successful for other professional groups.

With continued physical therapist competence defined as meeting or exceeding standards of contemporary physical therapist practice through the maintenance and augmentation of professional knowledge, skills, and abilities, the ABPTS sought to improve the recertification process by phasing in a continued competency model that will incorporate several new measures. These measures will include the following components: (1) evidence of professional standing, (2) evidence of commitment to lifelong learning through professional development, (3) evidence of cognitive expertise, and (4) evidence of practice performance.

Proposed Model for Maintenance of Specialist Certification

The American Board of Medical Specialties (ABMS) has addressed the issue of continued competence with regard to the credentialing of specialty areas in medicine. The ABMS established a task force on competence of physicians and this group developed a trademarked program entitled "Maintenance of Certification" that consists of 4 key elements, including evidence of (1) professional standing, (2) commitment to lifelong learning, (3) cognitive expertise, and (4) evaluation of practice performance.[3-5] In order to assure the consumer of ongoing quality and safety of patient care, there is a need to design re-credentialing processes which includes evidence of multiple aspects of patient care rather than just documenting of practice hours and associated specialist activities.

The ABPTS has developed a model for credentialing that focuses on continued competence of the physical therapist specialist. This new model has been titled the "Maintenance of Specialist Certification" (MOSC) and includes the following elements:

1. Professional Standing and Direct Patient Care Hours
2. Commitment to Lifelong Learning through Professional Development
3. Practice Performance through Examples of Patient Care and Clinical Reasoning
4. Cognitive Expertise through a Test of Knowledge in the Specialty Area

In June 2009, a work group was established by ABPTS comprised of current and past ABPTS members, and representatives from the ABPTS specialty councils. This work group was tasked with proposing requirements to meet each of the above elements. The outcomes of their deliberations are detailed below.

After certification or re-certification, a 10-year MOSC cycle begins during which the specialist must demonstrate the following evidence of continued competence. This 10-year cycle is then divided into 3-year intervals. The first 3 requirements must be fulfilled during each 3-year interval. The fourth requirement must be fulfilled during the 10th year.

Requirement 1: Professional Standing and Direct Patient Care Hours

- In or by years 3, 6, and 9, a specialist must submit evidence of current licensure as a physical therapist in the United States or any of its possessions or territories.
- In or by years 3, 6, and 9, a specialist must submit evidence of 200 hours of direct patient care acquired in the specialty area within the last 3 years. Direct patient care hours accrued in year 10 may be applied to the year 3 requirements for the next MOSC cycle. Direct patient care must include activities in each of the elements of patient/client management applicable to the specialty area and included in the appropriate *Description of Specialty Practice*. These elements, as defined in the *Guide to Physical Therapist Practice*, are examination, evaluation, diagnosis, prognosis, and intervention. Please see the Appendix for a listing of what constitutes direct patient care hours.

Requirement 2: Commitment to Life Long Learning through Professional Development

The American Board of Physical Therapy Specialties (ABPTS) supports the concept of professional development as an ongoing process to promote personal and professional growth. Each board-certified specialist is obligated to participate in ongoing professional development, within their designated specialty area, which leads to a level of practice consistent with acceptable standards. Each specialist may choose to pursue professional development, which leads to a level of practice beyond prevailing standards.

A web-based system to track continuing competence in a specialty area will provide an individual account tracking mechanism for each specialist to record professional development activities during their 1 to 3 year cycle, 4 to 6 year cycle, and 7 to 9 year cycle. There is not an hour requirement in this area but the specialist must show evidence of professional development activities (equivalent to 10 MOSC credits) within 2 of the 3 designated activity categories by years 3, 6, and 9. The following describe the 3 categories:

Category 1: Accrual of 200 clinical supervision and consultation and/or direct patient care hours (beyond the minimum required hours of 200 every 3 years), as well as professional services (subject matter expert, committee participation; item writing in specialty area; administrative activities; starting a residency; community service specific to specialty area)

Category 2: Completion of continuing education (CE) course(s), completion of college or university courses, teaching a college or university course, teaching a CE course

Category 3: Professional presentations, research activities, professional writing

By year 9, a specialist must have accrued a minimum of 30 MOSC credits, and demonstrated professional development in each of the 3 designated activity categories.

Requirement 3: Practice Performance through Examples of Clinical Care and Reasoning

The purpose of this requirement is to document continued competency in patient/client management in the specialty area. Patient management in a clinical case reveals clinical reasoning skills that are essential to demonstrating competency in the physical therapy specialty area.

The specialist will use an online system to complete one reflective portfolio submission in years 3, 6, and 9 of their certification cycle. These reflective portfolio submissions will be used to demonstrate the clinical care and reasoning that is used by the specialist. Each submission must have a reflective component, and must have documentation that reflects clinical reasoning.

The current proposal is to use the Physi-

cal Therapy Clinical Reasoning and Reflection Tool (PT-CRT) as developed by H.L. Atkinson, PT, DPT, NCS, and Kim Nixon-Cave, PT, PhD, PCS.[6] This reflection tool would serve as a base template to capture information for the reflective portfolio submissions. Additions to this template may be proposed by the ABPTS specialty councils in order to meet additional specialty requirements.

These reflective portfolio submissions would not be scored, but screened for completion of required information and reflection. The ABPTS staff have available an online system used for such screening.

Requirement 4: Cognitive expertise through a Test of Knowledge in the Profession

During year 10 of the certification cycle, the specialist will be required to sit for a recertification examination, comprised of approximately 100 items. The exam will be specialty specific, assess an individual's cognitive expertise in their specialty area, and reflect contemporary specialist practice.

There will be an effort to find ways to account for the fact that clinical specialists often subspecialize as they progress in their careers and look for categories that represent knowledge where maintenance of competency is essential. The first exam will be administered in 2023 so the determination of these content areas is still in process.

Successful completion of requirements 1 through 3 is a prerequisite for sitting for the recertification examination. If a specialist fails to receive a passing score after his or her first attempt, he or she will be permitted to sit for the exam one additional time and will maintain the credential during this one-year grace period.

WHAT DOES THIS MEAN FOR RECIPIENTS OF CERTIFICATION?

The MOSC program takes effect for specialists who certified or recertified in 2013, including those that recertified early for expiration in 2013. The official year of recertification is counted in 10-year increments from initial certification even if you recertify early. Any clinical specialist certified or recertified prior to 2013 will use the prior recertification model at the 10-year mark, after which they will enter into the MOSC system. Taking the initial certification examination is still an alternative to submitting the PDP, reflection, and practice hours at each of these points. At year 10, all individuals who met all MOSC requirements will be expected to take the 100-item recertification exam. The cost of the MOSC process is expected to be similar to current recertification process costs, but split across the different intervals.

Those certified or recertified in 2013, 2014, and 2015 have been granted an exemption for requirements 1 through 3 during the first 3-year interval, so it is expected that tracking of MOSC submissions will begin in earnest in 2016 starting with the year 4 to 6 cycle for certification years 2013, 2014, and 2015. Those who are certified or recertified on or after 6/1/2016 will immediately enter the MOSC process.

The table represents a standard cycle using a certification expiration date of 2016.

DISCUSSION

The ABPTS is committed to the MOSC model to promote the following:

1. The highest possible level of care for individuals seeking physical therapy services in each specialty area.
2. To provide a reliable and valid method for not only certification but recertification of individuals who have attained an advanced level of knowledge and skill in each specialty area.

Patients/clients benefit from improvement in quality and safety, and physical therapists benefit from the increased awareness of the quality of their practice and the facilitation of being a lifelong learner.

The new requirements of the MOSC model are intended to improve patient care while minimizing the intrusiveness and onerousness of the MOSC process. Such requirements will likely be mandated by health care purchasers or governmental agencies by methods that could very well be burdensome and/or intrusive. As mentioned, MOSC in essence will enhance the meaning of specialty certification as a standard of quality and a physical therapist's commitment to continual practice improvement and lifelong learning.

The MOSC is focused on each specialist competencies ensuring we maintain professional credibility with the public, while fostering the best and safe patient care, professional development, and practice improvement. Nearly 100 years ago, Ernest Codman said, "The science of medicine, however sophisticated it may be, is always in the experimental stage."[7] With the rapid advances in knowledge and technology, it is imperative physical therapists engage in this effort of quality through embracing continued competency.

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Table.

Certification date	Years 1-3	Years 4-6	Years 7-9	Year 10
Initial Certification 6/1/2016	6/1/2016-5/31/2019 (years 1,2,3)	6/1/2022-5/31/2025	6/1/2022-5/31/2025	6/1/2025-6/1/2026
Recertification 6/1/2026	6/1/2025-5/31/2029 (years 10, 1,2,3)	6/1/2029-5/31/2032	6/1/2032-5/31/2035	6/1/2035-6/1/2036

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What Activities Constitute Direct Patient Care?

Because each situation is different, there is no specific list of activities that may always be included or excluded as direct patient care. However, a guiding principle to consider for defining direct patient care is: **the activities that a therapist participates in that have a direct influence on the care of a specific patient or client. This work can be fee based or pro bono work.** Please note that eligible direct patient care hours only include the time spent practicing within your specific specialty area.

Some examples of approved direct patient care activities:

1. Team meetings where the needs of one or more specific patients are discussed and evaluated, regardless of whether or not the patient and family are present.
2. Your consultation services if your evaluation and input directly impact a specific patient.
3. Time utilized to prepare home exercise programs for specific patients.
4. Time spent reviewing medical records prior to seeing a specific patient or patients.
5. For senior therapists or heads of departments, time spent reviewing the physical therapy documentation in the records of all of the patients in his/her unit. ***However, please remember that these hours can only be utilized once and cannot also be used for other categories such as administration.***
6. Time spent teaching a family how to help or care for a specific patient through a home exercise program.
7. Screening of individual participants in a community senior center for risk of falls.
8. Screening of new clients of a fitness center in order to prevent injury once they start exercising.
9. Involvement in a research project where patients are directly influenced or affected by your interaction. This interaction can be on a one-on-one basis or in a group setting, as long as the care of the patient or patients are directly influenced or affected by your interaction. ***However, please remember that these hours can only be utilized once and cannot also be used to calculate research activities points.***
10. If you teach a course that involves working with a group of students to evaluate and treat a specific patient or patients, the time spent in this activity that has a direct influence on a specific person counts towards your direct patient care hours. ***However, please remember that these hours could also count as clinical supervision but cannot be allocated to both categories in the Professional Development Portfolio.***
11. Time spent providing feedback on a written case from one of your students that is on a clinical affiliation, **for a patient the student is currently treating**. This feedback should be discussed with their clinical instructor and changes implemented as needed.
12. Time spent providing acute care and injury management for athletes in venues where athletes practice and compete.

Appendix.

Book Reviews

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

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

Clinical Exercise Pathophysiology for Physical Therapy: Examination, Testing, and Exercise Prescription for Movement-Related Disorders. Slack Incorporated, 2015, $93.95
ISBN: 9781617116452, 589 pages, Hard Cover

Editor: Coglianese, Debra, PT, DPT, OCS, ATC

Description: Written by authors who are experts in the field, this comprehensive book covers both normal and pathological responses to exercise, examination and testing information, and clinical case studies for many types of patient populations. **Purpose:** Currently available books do not fully cover normal and abnormal responses to exercise in different patient populations. That's the purpose of this book. To augment the learning experience, it also includes clinical case studies. Having a single resource to cover all of these aspects is important. **Audience:** The intended audience is physical therapists of all levels. The book is also suitable as a reference for physical therapy students. **Features:** The first of the book's three sections covers foundational information about the cardiovascular and pulmonary systems, including the development and aging of these systems. The second section details specifics of deconditioning and principles of exercise prescription as they relate to patients, not athletes. The third section covers specific patient populations, detailing the physiology of the systems involved, the pathophysiology, and how to examine, evaluate, and treat the various populations. All chapters are organized in a similar format and style. Objectives and an outline of the material to be covered appear at the beginning of each chapter. Except for the first one, each chapter presents at least one case scenario. **Assessment:** This is a useful addition to the field of physical therapy. Chapters are comprehensive, well organized, and easy to follow, enabling both students and licensed physical therapists to get the most from the book.

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K-Taping: An Illustrated Guide: Basics, Techniques, Indications, 2nd Edition. Springer, 2014, $69.99
ISBN: 9783662435724, 247 pages, Soft Cover

Author: Kumbrink, Birgit

Description: This instructional manual provides background on K-taping methods and functions and outlines a wide variety of applications for use of elastic tape in physical therapy settings. **Purpose:** This is intended to serve as a reference for trained "K-Tapers" and as a useful everyday tool for practitioners, according to the author. **Audience:** The author identifies the audience as those who are already trained "K-Tapers," noting that those who wish to use the taping techniques in the book should first complete courses in the K-Taping Academy. She states that these methods can be used to support the work of doctors and physical therapists. Although this book focuses on the use of the specific brand, K-Tape, there is no reason that those who use other brands wouldn't benefit from the same principles. **Features:** The first two chapters cover the functions and methods of using elastic tape for therapeutic purposes as well as the application techniques. These chapters include background information, pictures, diagrams, memos, and important notes. The subsequent seven chapters cover application of elastic tape for muscle, ligament, corrective, lymphatic, neurological, gynecological, and other specific conditions. These chapters detail indications for use, instructions on how to apply and use the taping techniques, along with appropriate anatomic and physiological information. Also included are special tips, memos, photographs, and relevant anatomical illustrations. **Assessment:** The use of elastic taping for therapeutic purposes has significantly increased in popularity over the past few years. Many therapists are either familiar with it or use it regularly in the clinic. Therefore, I suspect that this type of manual could be well received by clinicians. The book is clear and concise with sufficient information and detail to fulfill the author's purpose. It covers an impressive array of applications, many of which may be unknown to clinicians. It can be a great reference for those who already know how to apply elastic tape, but would like examples of specific applications. However, for those who have no experience with this type of taping, it is not a replacement for attending a course.

Justin G Schaedle, PT, DPT, OCS
Butler County Physical Therapy

The Color Atlas of Physical Therapy. McGraw-Hill Companies, 2015, $110
ISBN: 9780071813518, 1396 pages, Hard Cover

Editor: Shamus, Eric, PhD, DPT, PT, CSCS

Description: This is a comprehensive atlas depicting the medical, orthopedic, neurological, pediatric, women's health, and vestibular disorders that physical therapists are most likely to encounter in patients in their daily practice. **Purpose:** The author discusses the implications of screening and its importance to the future of physical therapy. He notes the necessity of physical therapists screening their current patient caseload based on the fact that they see patients with a variety of disorders and impairments whose functional abilities are ultimately affected. **Audience:** The atlas is intended for all levels of clinicians, from students to specialists. **Features:** Using a consistent design, the atlas presents each disorder with its synonyms, the ICD-9 and ICD-10 codes, preferred practice patterns from the *Guide to Physical Therapist Practice*, and examination and treatment categories for each disorder. A patient presentation, or case study, is included, as are the key features of description, essentials of diagnosis, general considerations of each diagnosis, and demographics. Clinical findings for each disorder, such as signs and symptoms, functional implications, possible contributing causes, and differential diagnoses help clinicians in ruling out other diagnoses. Other methods, such as laboratory tests or imaging results needed to confirm a diagnosis and to rule out other disorders, are detailed. Treatments, including

medications and referrals to other healthcare providers are provided. Furthermore, discussion of each disorder encompasses impairments, tests and measures, interventions, functional goals, and prognoses. Finally, patient resources and references are presented. **Assessment:** This book provides abundant information from all facets of medicine important for physical therapy practitioners. It is an excellent source of information for therapists and students in training. The numerous figures and photos enhance comprehension and can be shared with patients as well. The book arms readers with ideas regarding physical therapy tests and measures as well as functional goal suggestions that can be immediately used in the clinic.

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

Prevention Practice and Health Promotion: A Health Care Professional's Guide to Health, Fitness, and Wellness, 2nd Edition. Slack Incorporated, 2015, $67.95
ISBN: 9781617110849, 371 pages, Soft Cover

Editor: Thompson, Catherine Rush, PT, PhD, MS

Description: This is an update of a book with evidence-based resources useful for all healthcare professionals to help prevent injury and illness while promoting wellness in their clients. It also provides links to a PowerPoint presentation which may be used by faculty to augment their lecture material. This feature, however, is not available to those who are not faculty members. The previous edition, published in 2007, was titled *Prevention Practice: A Physical Therapist's Guide to Health, Fitness, and Wellness*. **Purpose:** The primary purpose is to provide evidence-based health screening material for use by healthcare professionals for the promotion of health and wellness. These health screens can assist healthcare workers in detecting and preventing health problems, as well as help in identifying risky behaviors that may lead to a lack of well-being and wellness. It also provides information on a range of health problems that may be useful for educating their clients in the prevention of illness or injury. In doing so, the book addresses wellness in all its components: mental, physical, spiritual, psychosocial, and environmental. **Audience:** Healthcare professional students and clinicians involved in health and fitness may find this book useful in promoting client wellness and wellness programs. The intent of the book is admirable, with knowledgeable authors presenting the generalized concepts well. Because the information is somewhat generalized, however, the book is more useful to health and wellness practitioners, such as personal trainers, acupuncturists, and massage therapists, than it will be to those in professions which require an advanced medical degree, e.g., physical therapists, nurses, and physicians, for example. **Features:** The book covers wellness and health related topics throughout the lifespan, including screening tools and health disease information from infancy into older adulthood as well as information on preventive practices for the cardiopulmonary, musculoskeletal, and neurological systems. The chapter on women's health issues is especially informative and includes information about fitness during pregnancy as well as changes in the body during pregnancy. Unusual yet informative chapters on preventive care advocacy, health and wellness marketing, and business management are also useful. **Assessment:** This is a good resource for fitness and healthcare professionals needing basic screening tools for health promotion and prevention. It provides generalized information on health topics throughout the lifespan to facilitate client education and wellness. Of note, throughout the book the author references websites to allow for self-study of more in-depth information on health topics and screening tools.

Jennifer Hoffman, PT, DPT, OCS
Touro University Nevada

Your Best Pregnancy: The Ultimate Guide to Easing the Aches, Pains and Uncomfortable Side Effects During Each Stage of Your Pregnancy. Demos Medical Publishing, 2014, $19.95
ISBN: 9781936303618, 227 pages, Soft Cover

Authors: Hoefs, Jill, MPT; Jagroo, Denise, DPT, MTC, WCS

Description: This guide gives expectant mothers advice on ways to reduce pains and strains related to pregnancy, labor, and caring for a newborn. It has advice on preventing pain as well as steps for reducing common pains related to pregnancy, using real cases to describe common conditions and treatment. **Purpose:** The intention is to provide physical therapy advice to women who are suffering from painful conditions related to pregnancy, particularly for those who do not have access to a women's health specialist or who have been told there is nothing that can be done for their pain. Many women are unaware of physical therapy as a treatment option and this book gives practical information about pregnancy-related conditions that physical therapists treat as well as how the treatments work. **Audience:** This book is intended for the general public, though it could be a good resource for clinicians to have on hand to share with pregnant clients. The authors are both practicing women's health physical therapists, and one is board certified in women's health. **Features:** The eight chapters cover common painful conditions of pregnancy, the importance of exercise in prevention, safe activities while on bed rest, childbirth preparation, and postpartum care. The tone of the book is more conversational than academic and uses real cases to describe conditions and treatments. The chapter on the pelvic floor does a good job of describing the pelvic floor function as well as exercises and strategies to engage these muscles properly in terms that the general public can easily understand. The chapter on postpartum care is slight and could use more information and illustrations on safe exercise for this stage of healing. **Assessment:** This is a good book for women experiencing pregnancy-related disorders. The conversational tone makes it an easier read than other resources and the tips are very practical. It is particularly useful for those who do not have access to physical therapy, although it can be a good reference for physical therapists to share with pregnant clients. It has detailed and practical information for women and promotes the benefits of exercise and physical therapy in maintaining a healthy pregnancy.

Monique Serpas, PT, DPT, OCS
Touro Infirmary

Congratulations

Recipients of the PTA Advanced Proficiency!

The Orthopaedic Section is proud to recognize that the following Orthopaedic Section members have met all of the eligibility requirements for the 2014-2015 American Physical Therapy Association's Physical Therapist Assistant (PTA) Recognition of Advanced Proficiency:

Member Proficiency Area

Christa Petersen Fields, PTA Musculoskeletal
James Nicholas Holcomb, PTA, CLT Musculoskeletal
Tanya Kay Powell, PTA Musculoskeletal
Brandi Soltis, PTA Musculoskeletal
Heather Anne Van Grootheest, PTA Education

As recipients of APTA's PTA Recognition of Advanced Proficiency, all received a certificate of advanced proficiency suitable for framing, a lapel pin, and recognition in the July issue of PT in Motion.

Recipients were recognized during APTA's Honors and Awards Ceremony at the NEXT 2015 Conference and Exposition in National Harbor, Maryland, held this past June.

2016 Mary McMillan and John H.P. Maley Lecturers

The APTA has announced that Carole B. Lewis, PT, DPT, PhD, MPA, GCS, GTC, CCOEE, MSG, FAPTA, is the 2016 Mary McMillan Lecturer and Steven Z. George, PT, PhD, is the 2016 John H.P. Maley Lecturer. The Mary McMillan Lecture Award acknowledges and honors a member of the APTA who has made a distinguished contribution to the profession, and provides the recipient with an opportunity to share her achievements and ideas with members through a lecture presented at the NEXT conference. The John H.P. Maley Lecture recognizes a physical therapist member who has made a significant contribution to the profession in the area of clinical practice. Dr Lewis and Dr George will present their lectures at the NEXT 2016 Conference and Exposition next June in Nashville, TN.

Congratulations, Dr Carole Lewis & Dr Steven George!

APTA 2015 House of Delegates Election Results Announced

The following Orthopaedic Section members were elected to APTA's Board of Directors at the House of Delegates in National Harbor, Maryland.

Sharon L. Dunn, PT, PhD, OCS, was elected president.

Susan A. Appling, PT, DPT, PhD, OCS, and Robert H. Rowe, PT, DPT, DMT, MHS, FAAOMPT, were elected directors.

Congratulations!

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

President's Message

Lorena Pettet Payne, PT, MPA, OCS

The OHSIG would like to welcome new members. Watch for upcoming email and short podcasts regarding our specialty practice. You are always welcome to contribute by sending information about your practice, letting us know of speaking engagements with other related organizations, your willingness to be listed on a speaker's bureau, submitting an article for this section of the *Orthopaedic Physical Therapy Practice* magazine or joining a work group. If you would like to add to the work of the SIG, contact a Board member. Contact information is listed under special interest groups within the Orthopaedic Section website.

Something to think about: As a group, are we still referring to "work hardening" and "work conditioning?" The Advanced Work Rehabilitation guideline that can be found at the OHSIG website outlines updated language and construct for "work rehabilitation." The level of complexity (levels 1-4) guides decision making and planning by the physical therapist with the ultimate goal of a return to full duty work. I invite you to familiarize yourself with this information so that all stakeholders begin to define the process similarly.

Is Sitting Killing the American Work Force?

Bob Patterson, MPT, MBA, CAE

Sitting has become a way of life in modern America. The average American sits 13 hours per day; 86% of Americans sit all day at work. Two-thirds of those state that they find the prolonged sitting hard to tolerate.[1] No arguments exist anymore that combat the notion that we have become a sedentary population. This transition has largely been driven by the shift in American work from light and moderate manufacturing to seated office work. The Bureau of Labor Statistics (BLS) reports that there are over 21 million people in office and administrative support occupations, over 3 million in computer and mathematical occupations, over 6 million in business and financial occupations, over 6 million in management occupations, and over 9 million in transportation and material moving occupations. Of course these BLS statistics do not include people who are inactive in other industries such as architecture, engineering, sales, sciences, legal, and health care, to name a few. That is a lot of people sitting through their work day. Dr Stacy Clemes, Senior Lecturer in Human Biology, Loughborough University reveals that during waking hours 65% of an average person's day is sedentary. That equates to 9 to 10 hours per day for adults. Dr Clemes also discovered that if you tend to be more sedentary at work, you will also tend to be more sedentary at home. Her data shows that even on weekends, people still sit for 8 hours. Additionally, sedentary workers do not tend to compensate by increasing activity in their leisure time.[2]

Peering back through time, we have learned of the musculoskeletal hazards of sitting. Lumber disk dysfunction, thoracic and cervical spine discomfort, and upper quarter disorders, to name a few, have all been associated at some point in time with overuse and static seated work postures. With the rise of the knowledge-based work force requiring the use of computers all day, these conditions have become increasing prevalent to the point that it is now widely recognized and accepted that ergonomic remedies should be applied proactively to prevent common musculoskeletal disorders (MSD), manage risk factors, and speed recovery when those conditions develop.

As a reaction, occupational health professionals have seen a barrage of requests from physicians, employees, workers' compensation claimants, and clinical patients for sit/stand workstation adaptations. Research has shown that such modifications can help control musculoskeletal symptoms.[1,3] This trend has emerged as a direct result of health experts linking sitting to musculoskeletal health hazards. But a new data trend is emerging that links sitting not only to musculoskeletal conditions, but also to more severe metabolic health conditions, and even death. A Mayo Clinic endocrinologist, James Levine, recently stated that "A growing body of evidence that suggests chair living is lethal. Of concern is that for most people in the developed world, chair living is the norm…The chair is out to kill

us." Anup Kanodia, a physician and researcher at the Center for Personalized Health Care at Ohio State University's Wexner Medical Center, purports that "Sitting is the new smoking." Never has the risk of sitting been more emphatically proclaimed than recently. The chair is out to kill us? Sitting is as hazardous as smoking? Is this hyperbole? How can a chair kill somebody or cause as much known harm as cigarette smoking? What should be the rationale for changing the work environment from sitting to a sit/stand, aside from the volumes of literature proclaiming the hazards of sitting and static positioning in developing musculoskeletal conditions? Surely these critics of the sitting posture cannot imply that sitting hazards extend beyond the musculoskeletal? Or are they?

This question has been explored in recent studies linking prolonged sitting to more diabolical health conditions such as diabetes, heart disease, and obesity. Recent research challenges the commonly held notion that those suffering from these metabolic conditions are more inclined to stasis because of their condition. Quite the contrary! Sitting is now circumstantially being blamed as a primary cause of these serious health conditions, particularly the root underlying source—obesity. Trend analyses reveal that the rise in prevalence of these health conditions follows an alarmingly similar trajectory to the rise in prevalence of sitting and sedentary activity levels while working. This suggests that work while sitting is actually causing these conditions, not the other way around.

What is being done to combat sitting as a driver of life-threatening metabolic conditions? The American Medical Association (AMA) has adopted a policy recognizing potential risks of prolonged sitting. The policy encourages employers, employees, and others to make alternatives to sitting, such as standing workstations and isometric balls, available. Dr Harris of the AMA states that, "Prolonged sitting, particularly in work setting, can cause health problems. And encouraging workplaces to offer employees alternatives to sitting all day will help to create a healthier workforce." The recognition of sitting as a health hazard is not a notion dwelling in the shadows in health and wellness circles. Rather, research is now recognizing sitting as a mainstream health hazard requiring appropriate remedies.

Pennington Biomedical Research Center in Baton Rouge, LA, followed 17,000 Canadians over 12 years and found that those who sit for most of the day were 54% more likely to die of heart attacks than those who did not. In May and July 2010, two studies were published, which both found that sitting was positively correlated with adverse health outcomes, EVEN IN participants who exercised and met minimum daily activity guidelines. It was the first articulation that "too much sitting" is distinct from "too little exercise."[5,6] In August 2011, Australian researchers succeeded in identifying reductions in life expectancy associated with each hour spent sitting and watching TV. They correlated every hour of TV watched after age 25 with a 22-minute reduction in life expectancy.[7]

We are still experiencing the initial wave of response to the emerging data in the workforce performance, wellness, ergonomic, and furniture industries. In fact, ergonomic and office furniture markets have responded reflexively with ever-multiplying alternatives to sitting—mostly toward the adoption of sit/stand workstations. This response is understandable. It stands to reason that if sitting is the problem, why not simply offer standing as an option? In fact, because the medical and ergonomic communities were already trending toward the sit/stand work environment in an effort to address musculoskeletal conditions, the news that sitting causes more severe health problems only served to fuel the marketing machine in the ergonomic and office furniture industries. Dozens of new entrants to the sit/stand marketplace have emerged. In the past 5 years, the number and breadth of offerings for sit/stand options has increased several fold. Sit/stand options are now ubiquitous at trade shows and industry events. They were hardly noticeable only a few years ago.

The reaction of the marketplace to demand in this space is clear and purposeful. However, we are nowhere close to the peak of this trend. Pricing for sit/stand options has yet to respond to the increase in supply in the marketplace. Prices should decrease as the supply increases. However, costs remain high. If we apply fundamental economic theory (supply and demand), we must conclude that if pricing has not yet adjusted downward, demand relative to supply is still very high. As such, the prices of sit/stand workstations remains high. The trend surges onward.

This is all very good news for furniture and equipment manufacturers. High demand AND high prices—that is a recipe for profit-taking. But there is a problem on the horizon for the sit/stand furniture and equipment industry—simply changing the work environment from one in which the worker is statically positioned sitting to one in which the worker must endure a static standing posture—does not actually change the risk of deadly health conditions. In fact, in many ways, standing does very little to change that risk. Recent research is showing that static, prolonged standing is as hazardous to our health as sitting. Stationary standing is correlated with extremely high incidence of low back pain, even in participants who had no prior history of low back discomfort.[8] Additionally, people working in a fixed standing posture are at a significantly greater risk of cardiovascular disease, blood clots, etc, than those working in a fixed sitting posture.[9-11]

So what should be done? In order to answer this question, let's look at the facts about how standing can might influence metabolic rates and induce Non-Exercise Activity Thermogenesis (NEAT). Sitting at a workstation all day is a sedentary activity. The Metabolic Equivalent (MET) is at about 1.5. Standing barely exceeds the MET rate of sitting and only barely surpasses the 2.0 MET threshold required for classification of standing as "light activity" from "sedentary." Neither posture is beneficial from a MET or NEAT perspective. As discussed earlier, this is bad news for the American workforce.[4] We continue the trend toward "light" and "sedentary" work. As this continues, so will follow the adverse health conditions associated with it.

As physical therapists working in the clinical environment or in an industrial environment to help prevent and treat injuries and adverse health conditions, what can we do to cause a positive change in our patients' and clients' health risks? The flexibility of being able to alternate between sitting and standing, as afforded by sit/stand stations, is not necessarily the answer to the problem. Research shows that without proper training, the rate of adoption and the positive physical effects of an alternated sit/stand work posture post-implementation may not be sustainable. In order for sit/stand stations to be effective, the equipment must be provided along with specific training on use, a supportive management climate, and a participatory organizational culture. Without this people do not really use

the sit/stand features very much. They choose either sitting or standing and stick with it. They do not alternate. Sitting is usually replaced exclusively by standing when a sit/stand station is used. Sit/stand stations do not drive meaningful improvement in the total number of steps taken per day.[12] Also, self-reported comfort measures and symptoms sometimes improve with sit/stand stations, but more high quality research needs to be generated before we can make this conclusion. Regular movement appears to be the only remedy to halt and reverse the effects of prolonged stasis of sitting or standing.

Based on these facts, when we consider what physical therapists can do in the industrial environments in which we practice, physical therapists are uniquely suited to address the movement training and implementation practices that must be followed when addressing the hazards of static work through combined sit/stand work environments. Facilitating movement is in our collective DNA. Knowing that simply installing a sit/stand workstation is not the answer to all the woes of the modern sedentary workforce will help us address these issues as they arise in our respective practices.

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STAND UP AND MOVE – movement programs centered on regular and frequent breaks will help. Here is a suggested movement program that delivers results:

- **Stand up & bounce around for a minute every 15 minutes AND**
- **Take a 5 minute walking rest break each hour AND**
- **Take a 10 minute brisk walk at lunch AND**
- **When watching TV, always MOVE during commercials or network breaks.**

All of these steps will drive an increase of the overall MET rate by 3.74 METs from about 1.6 (the MET rate for static standing for 8 hours). These steps will also help to restore blood flow to working tissues, thereby reducing musculoskeletal strain.

PERFORMING ARTS

SPECIAL INTEREST GROUP

President's Letter

Annette Karim, PT, DPT, OCS, FAAOMPT

A frequently asked question is "What is the difference between a residency and a fellowship?" As a graduate of both an APTA-credentialed orthopaedic residency and APTA-credentialed orthopaedic manual therapy fellowship, I can say they are very different. The residency gave me an enormous amount of information and practice in orthopaedics, clinical reasoning, and teaching, while preparing me for the Specialist Certification in Orthopaedics (OCS) exam. The fellowship gave me a concise understanding of root causes related to movement dysfunctions, and helped me develop advanced clinical reasoning and manual skills. I look back with gratitude to the many colleagues who took me under their wing, and I look forward to the new colleagues who join us in providing advanced practice in Performing Arts Physical Therapy.

The focus of the PASIG in 2015 has been on facilitating the development of fellowship programs in the performing arts. There were questions to answers, such as:

(1) Is Performing Arts Physical Therapy a fellowship-level specialization?
(2) Does a Performing Arts Physical Therapy Fellowship require an OCS, or SCS, or APTA-credentialed residency graduation?
(3) Can the Performing Arts Physical Therapy Fellowship be subdivided into specific fellowships such as music, dance, theater, singing, and acting?
(4) Can the PASIG help get the ball rolling?

The answer is yes, to all of the above. The Orthopaedic Section Board has been helpful to us, as they have provided resources, connections, and a great deal of encouragement. Information from the Orthopaedic Section Residency and Fellowship Education Committee can be found at the APTA Orthopaedic Section website: https://www.orthopt.org/content/education/clinical_residency_and_fellowship_programs.

The American Board of Physical Therapy Residency and Fellowship Education has also been a great help to our PASIG Fellowship Task Force in developing a Description of Fellowship Practice (DFP): http://www.abptrfe.org/home.aspx.

One last website to look at as we develop the DFP is the American Board of Physical Therapy Specialties: http://www.abpts.org/home.aspx.

News from the PASIG Fellowship Task Force: Members of the PASIG have created a project team, led by Mariah Nierman, Fellowship Task Force Chair, to re-validate the 2004 Performing Arts Physical Therapy Description of Specialized Clinical Practice. The intent of this revalidation process is to provide current practice guidance for practitioners in the subspecialty field, update the 2004 DSCP to a Description of Advanced Specialized Practice (DASP) appropriate for fellowship level curriculum and expertise, and for the creation of a Description of Fellowship Practice (DFP) in Performing Arts Physical Therapy. The ABPTRFE has already approved the declaration of intent for this process. The practice analysis survey will be distributed this fall. Thank you in advance for participating in this survey. We recognize that your time is valuable. Participation from a broad sampling of clinicians is critical to the process and very much appreciated.

PASIG Board

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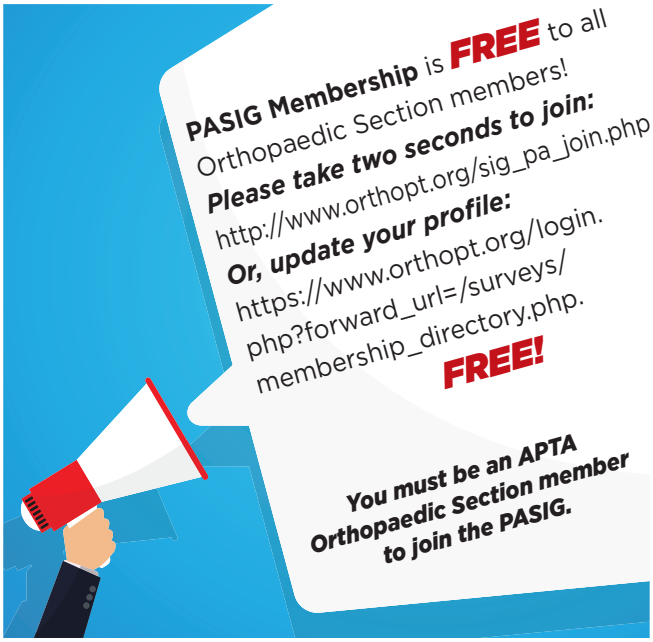

Clinical Corner: Hip External Rotation Exercise

Annette Karim, PT, DPT, OCS, FAAOMPT

At our clinic, we have used a developmental exercise in dancers who are having foot pain en pointe, related to the inability to activate end-range hip abduction and external rotation. It is an easy position to get into by starting with an "army crawl." After addressing positional faults through manual intervention, we found the dancers were able to move into correct patterns, but had difficulty maintaining the pattern during more demanding dance movement, such as single limb jumping and single limb rise onto pointe. The feedback from our dancers was an experience of immediate, painfree, improved physical performance, and the ability to "feel the turnout muscles" at end range.

This is an example is of the position that is achieved through the "army crawl," with the dancer lifting her left knee, the foot on the floor (Figure 1).

Figure 1.

This dancer had left shearing stress at the medial cuniform/1st metatarsal joint. In this post-exercise photo, she demonstrates painfree, correct placement of the lower limb (Figure 2).

Figure 2.

Look at the right heel of the second dancer. The shank of the pointe shoe is slanted and shifted to the right. This demonstrates poor loading onto pointe, and creates a shearing on the Achilles tendon as the dancer transitions back to demi-pointe. There is painful gripping of the long toe flexor tendons and Achilles tendon, with the dancer unable to "pull up," evidenced by the blanching under the posterior dance ribbons (Figure 3).

Figure 3.

This is the dancer rotating her right hip in a modified position that is comfortable and familiar to her (Figure 4).

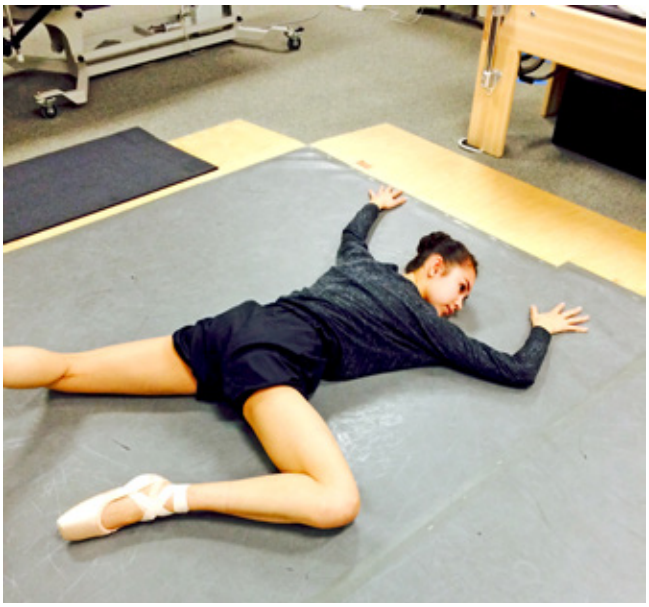

Figure 4.

The posttreatment response was favorable after two repetitions, held for 10 seconds each. The dancer's shank is better positioned, and the posterior ankle is pulled up, not blanched, and is painfree (Figure 5).

Figure 5.

Special thanks to my colleague, Clare Frank, PT, DPT, MS, OCS, FAAOMPT, my fellow, Lucas Pratt, PT, DPT, MTC, and my student, Alissa Sanchez, SPT, for their contributions.

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

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

FOOT & ANKLE

FOOT & ANKLE
SPECIAL INTEREST GROUP

SPECIAL INTEREST GROUP

Minimum Standards and Future Directions

What an exciting time it is for researchers and clinicians who regularly treat foot and ankle conditions! This column is devoted to exploring current research involving the foot and ankle, and also represents our SIG contribution to diagnosis, treatment, and instruction.

Entry-level Curriculum Recommendations

The FASIG is excited to announce the completion of a 4-year process in the development of minimum curriculum standards for the foot and ankle. "Foot and Ankle Curriculum Content for the Entry-level Physical Therapist" is a document now available by link on the Orthopaedic Section website. The primary purpose of this paper is to assist the orthopaedic instruction of entry-level therapists by establishing minimal competencies in the examination, treatment, and diagnosis of a variety of foot conditions. This document is intended for any and all stakeholders in the education preparation of our future physical therapists. In particular, orthopaedic instructors are encouraged to use the document as an instructional aid.

A 35-member Task Force first met in November 2011 to begin the process of providing conformity and consistency in the orthopaedic instruction of foot and ankle material to all 206 physical therapy programs across the country. An earlier survey of physical therapy program directors and orthopaedic instructors indicated the need for base-line curriculum content. At the same time, the Task Force intended to provide instructional background materials, including references, citations, and patient cases, to assist the orthopaedic instructor.

Over the last 3 years, the document has been vetted, reviewed, amended, altered, and grammatically checked. An initial version was presented at CSM 2014, where additional input was gathered, and further changes were implemented. The FASIG is proud of this document.

The authors of this very large and impressive document should be credited; the original 35 member Task Force is listed in the document and should be applauded for their efforts. As you will see from the list, the Task Force was a representative example of the talent and experience that comes with the Orthopaedic Section and the Foot and Ankle Special Interest Group. Nonetheless, a few people deserve special mention:

- Chris Neville chaired the original Task Force meetings and spearheaded the project until completion. His leadership, vision, and organizational skills provided the foundation for the clarity and thoroughness of this entry-level document.
- Lisa Silverstein reviewed the entire document for content, references, grammar, and layout. Her meticulous attention to detail and cited references adds strength to this document.
- Todd Davenport, Stephanie Albin, and Steve Pettineo provided invaluable input regarding content and formatting.
- Tom McPoil, Steve Paulseth, and RobRoy Martin provided the impetus for the initial survey and guided the initial steps in forming a Task Force.
- Pam Duffy acted as the Orthopaedic Section Board liaison to the FASIG and provided critical guidance

Thanks again to ALL that assisted in this process!

Future Directions: A Randomized Controlled Trial You Should Check Out

Randomized Controlled Trial Comparing Orthosis Augmented by Either Stretching or Stretching and Strengthening for Stage II Tibialis Posterior Tendon Dysfunction

Jeff Houck, PT, PhD
Christopher Neville, PT, PhD
Josh Tome, MS
Adolf Flemister, MD

This recently published randomized controlled trial is from the *Foot and Ankle International*, the publication for the American Orthopedic Foot and Ankle Society. I wanted to bring attention to the article and acknowledge the authors. First, Jeff Houck and Chris Neville have been active in the Foot and Ankle Special Interest Group for several years. They have a long and impressive list of research papers, many of which deal with posterior tibialis tendon dysfunction. This article caught my attention because of its relevance to the clinician who treats foot and ankle disorders, as well as the strength of the study (level one).

Dr Houck and Dr Neville concluded that a moderate-intensity, home-based exercise program minimally improves outcomes over an orthosis alone in those with stage II tibialis posterior tendon dysfunction. I think this verifies what many clinicians encounter when we see this category of patient. However, take a closer look at the study, particularly, measurement of strength.

A custom-made isometric strength testing system that isolated the deep posterior compartment by resisting foot adduction was used. Please note that the authors were not just trying to measure uni-planar forces, but rather, they are attempting to isolate force production in the foot in different compartments, planes, and directions. In other words, following the lead of Dr Houck and Dr Neville, shouldn't we explore the force (and force attenuations) capabilities of the foot in all directions, planes, and axes? Are there other articulations where forces are produced in the foot? Are forces produced in the foot to propel gait, or to control it? Where are these forces occurring?

The answers to these questions could provide the physical therapist, who is specialized in diagnosis and treatment of the foot and ankle, with a brand new approach to strengthening and stabilizing the foot and ankle, and perhaps providing remedy to multiple dysfunctions and deformities.

IMAGING

SPECIAL INTEREST GROUP

Imaging Education Manual

The current status of diagnostic and procedural imaging in doctor of physical therapy education and practice is marked by variability and inconsistencies. Therefore, the Imaging Special Interest Group has developed the *Imaging Educational Manual for Doctor of Physical Therapy Professional Degree Programs (Imaging Education Manual)* to provide a valuable resource of information that will assist faculty in on-going curriculum assessment and development in this content area. The Imaging Education Manual and other resources can be accessed online at www.orthopt.org. Faculty responsible for teaching imaging content will likely find the evidence review and curriculum resource information useful in course development and for other aspects of instruction. Information in the manual will also be useful to faculty members who may be called upon to provide testimony or opinion when regulatory or legislative imaging issues arise in your state. In addition, academic coordinators of clinical education may wish to share materials in the manual with clinical instructors to facilitate further student development of relevant skills during clinical internships.

As physical therapist practice evolves, including patient direct access, the ability to refer patients directly for diagnostic imaging could enhance efficiency and effectiveness of care delivery. Doing so is contingent upon doctors of physical therapy having the requisite knowledge and skills of appropriate patient referral for imaging. Published research describing physical therapist use of ultrasound imaging (USI) in patient management has been growing since the 1990s. The practicality of incorporating USI at the point-of-care has been greatly enhanced with improvement in ultrasound technology resulting in smaller machines, higher and improved resolution, and much lower equipment costs.

Should you have any questions, please do not hesitate to contact any member of the Steering Committee or Imaging Special Interest Group of the Orthopaedic Section, APTA.

The Steering Committee writing the manual is comprised of:

Douglas White, DPT, OCS, RMSK, Chair
Bill Boisonnault, PT, DHSc, FAPTA
Bob Boyles, PT, DSc
Chuck Hazel, PT, PhD
Aimee Klein, PT, DPT, DSc, OCS
John Meyer, PT, DPT, OCS, FAFS
Becky Rodda, PT, DPT, OCS
Rich Souza, PT, PhD
Deydre Teyhen, PT, PhD, OCS

Call for Nominations

Positions open for 2015 election:
President
Nominating Committee-one to be elected

Imaging SIG Leadership

Douglas M. White, DPT, OCS, RMSK –
President dr.white@miltonortho.com
James "Jim" Elliot, PhD, PT, – Vice President
Nominating Committee
Richard Souza, PT, PhD, ATC, CSCS, Chair
Marcie Harris Hayes, PT, DPT, MSCI, OCS
Nancy Talbott, PhD, MS, PT
Joel Fallano, PT, DPT, MS, OCS – Publications Editor
Stephen C.F. McDavitt PT, DPT, MS AAOMPT -
Orthopaedic Section Board Liaison

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. 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 which help inform clinical practice.

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

Blue Cell Synovial Sarcoma in a Patient Presenting with Posterior Thigh Pain and Swelling

CPT Abe R. Dummar, DPT[1]
MAJ Bradley S. Tragord, DPT, DSc, OCS, FAAOMPT[1]
Lt Col Brian A. Young, PT, DSc, OCS, FAAOMPT[2]

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[2]US Army-Baylor University Doctoral Program in Physical Therapy, Ft Sam Houston, TX

The views expressed in this manuscript are those of the author(s) and do not reflect the official policy or position of the Department of the Army, Department of the Air Force, Department of the Defense, or the US Government.

The patient was a 34-year-old male nurse evaluated by a physical therapist for an insidious onset of right thigh pain that began two months prior. The patient complained of constant non-dermatomal throbbing in the right buttock and posterior thigh that travelled distally toward the lateral aspect of his leg. The pain was the worst at night and unimproved with rest. He initially presented to a chiropractic clinic where lumbar radiographs were obtained as part of the clinical examination. The patient completed 3 sessions of general lumbar manipulations augmented with general exercise. There were no changes in his symptoms despite treatment. The patient was also evaluated by a primary care provider and prescribed nonsteroidal anti-inflammatory medications, which did not help. Physical exam revealed antalgic gait with unwillingness to bear weight on the involved extremity, inability to find a position of comfort, non-pitting edema, swelling, and pain to the right middle to distal thigh with palpation. Active range of motion (AROM) for the hip was within normal limits except for flexion that was limited to 0° to 110° due to pain in the posterior buttock and thigh. The patient was also lacking 35° of active knee extension, and could not obtain greater than 100° of flexion due to both pain and swelling. When manual overpressure was applied to the hip and knee, it led to an increase in the diffuse throbbing pain from the buttock down to the back of leg and had an empty end feel.

The therapist's differentials included S1 radiculopathy, neuritis, deep vein thrombosis (DVT), cancer, and infection. The straight leg raise test was negative with no increase in pain or radicular symptoms. Results of the neurologic exam indicate that, the patient was intact to light touch for L2-S2 lower extremity dermatomes with 2+ knee and ankle reflexes that were equal bilateral. Grading from gross manual muscle testing revealed weakness of the right lower extremity due to pain at L2-L5 and 5/5 of S1-S2 myotomes. The Wells DVT criteria were applied with the localized tenderness along the deep venous system and entire lower extremity swelling resulting in a moderate probability for DVT.[1] The patient was not showing any blatant signs of infection and had no fever, chills, or increased respiration rate. The longevity and severity of symptoms, history of night pain, and failure to improve with conservative interventions, coupled with the above objective findings, was concerning for non-musculoskeletal pathology.

The patient was provided crutches and sent to the emergency department for medical evaluation. The evaluation included baseline radiographs, which according to the American College of Radiology is the most appropriate for a soft tissue mass and the second most appropriate is an MRI (Figure 1).[2] The radiographs suggested increased density in the soft tissue of the posterior compartment of the right thigh. Advanced imaging helped to further distinguish the lesion as a soft tissue synovial sarcoma (Figures 2 and 3). Computed tomography guided biopsy was performed one week later and confirmed the diagnosis of a round blue cell synovial sarcoma of the right posterior thigh compartment.

Appropriate screening by the physical therapist identified several red flags, along with failure to improve despite prior medical intervention. The majority of soft tissue sarcomas are found around the knee joint and early diagnosis is crucial.[3] The decision for a prompt referral with recommendations led to the definitive diagnosis and initiation of appropriate treatment. As of the time of this writing, the patient had undergone 11 chemotherapy and radiation therapy treatments.

Figure 1. Lateral view of the right thigh, femur and proximal soft tissue of the posterior compartment showing increased density.

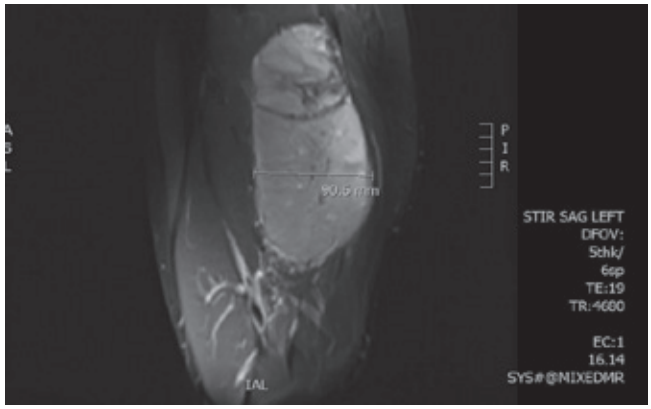

Figure 2. Sagittal STIR with measurement of 90.6 mm in width.

(Continued on page 192)

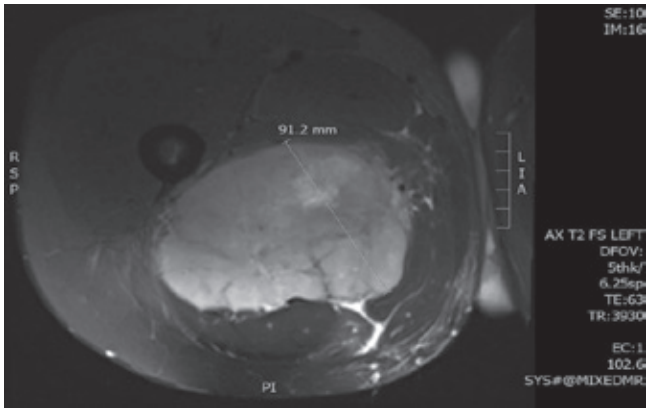

Figure 3. Axial cut depicting a synovial sarcoma of the posterior compartment.

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2. ACR Appropriateness Criteria® - American College of Radiology. https://acsearch.acr.org/docs/69434/Narrative/. Accessed September 23, 2014.
3. Park JH, Kang CH, Kim CH, Chae, IJ, Park JH. Highly malignant soft tissue sarcoma of the extremity with a delayed diagnosis. *World J Surg Oncol*. 2010;8:84. doi:10.1186/1477-7819-8-84.

Management of an Unstable Ankle Fracture

Robert E Boyles PT, DSc, OCS, FAAOMPT
Associate Clinical Professor, School of Physical Therapy, University of Puget Sound, Tacoma, WA

A 21-year-old male college baseball player self-referred to physical therapy with a 3-day history of a right ankle injury sustained during a recreational basketball game when he landed on another player's foot. He described an inversion type injury mechanism and felt a pop with immediate pain and swelling. He was unable to continue playing and had to be helped off the court. He attempted self-treating with ice, elevation, and the use of a friend's crutches. On evaluation, he was nonweight bearing using crutches; had marked effusion and edema of the leg, foot, and ankle; wide spread ecchymosis; and was unwilling to move the ankle secondary to pain. His neurovascular system distally was found to be unremarkable but there was marked pain to palpation at the lateral malleolus, with negative tenderness at the fibular head, medial malleolus and foot, and unable to weight bear one step on the injured extremity. Based on the history and physical examination, he fit the Ottawa ankle rules[1] for possible ankle fracture and was referred by the physical therapist for radiographic images of the ankle. The patient returned to the physical therapist following x-rays where it was determined the patient sustained a distal fibula fracture at the level of the mortise (Weber B) classified as a supination, external rotation (SER) IV fracture pattern (Figure 1). The patient was referred immediately to the orthopaedic clinic where the fracture was

Figure 1. Right ankle mortise view radiograph showing distal fibula fracture at the level of the joint (Weber B), SER IV pattern.

confirmed and further C-arm fluoroscopy stress images revealed widening of the mortise. The patient subsequently underwent open reduction internal fixation (ORIF) 4 days later, after swelling and effusion decreased. Following ORIF of the fibula, intraoperative stress views demonstrated an unstable mortise (Figure 2), requiring syndesmosis screw fixation (Figure 3). The patient successfully underwent surgical intervention and received post-op rehabilitation by the same physical therapist. This case highlights the usefulness of applying the Ottawa ankle rule as part of the diagnostic decision-making process. The appropriate interpretation led to successful management of this patient's injury.

REFERENCE

1. Stiell I. Ottawa ankle rules. *Can Fam Physician*. 1996;42:478-480.

(Continued on page 193)

Figure 2. Intraoperative fluoroscopic stress view demonstrating widening of the medial clear space greater than 4mm after fixation, requiring syndesmosis screw fixation for stabilization.

Figure 3. Postoperative x-ray image showing syndesmosis screw fixation.

ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT

If "WE" Fail To Define Our Practice, Then Who Will?

Animal rehab from a physical therapy standpoint is at a crossroads. The authority, and more importantly the obligation, to define the clinical practice of animal rehabilitation resides in "us" as members of the Animal Rehabilitation Special Interest Group. As noted in the heading of this section, if we fail in this task then trust me, individuals who do not practice on animals will be left questioning what we do, why we do it, and what educational background grants us the privilege to treat non-human species. Unless you are completely out of touch, these questions have already been asked many times over by some individuals who literally do wonder why some physical therapists are so interested in treating animals. It is therefore time to act on this issue and clarify what competencies are required to practice on animals.

If physical therapists and physical therapist assistants wish to gain credibility and ensure longevity of practice on animals, then conducting a quality Practice Analysis of animal rehabilitation is absolutely without hesitation a necessity. This is why a Task Force has been developed by the SIG officers to specifically achieve this goal. Task Force members have been participating in scheduled phone conferences to discuss 4 major topics:

(1) redesign and complete a comprehensive practice analysis on animal rehabilitation;
(2) complete a 50 state analysis of PT and Veterinary Practice Acts, including regulations, to determine current authority for physical therapists to practice on animals;
(3) review the current status of postgraduate educational opportunities for PTs and PTAs to gain competencies in animal rehab; and
4) draft a White Paper on PT Animal Rehabilitation in the United States.

Anticipated Outcomes of the Task Force

When the Task Force completes its goals as stated above, then 3 things will become possible: (1) the ARSIG can use the White Paper to educate and justify the practice of animal rehab to external constituencies including legislatures, other health professionals, and even members of our own profession; (2) publish the results of the practice analysis survey to establish a foundation for minimal competencies required to competently practice on animals by PTs and PTAs; and (3) facilitate the ARSIG's role as a political advocate to assist state jurisdictions in creating legal language to address scope of practice revisions as needed.

The following table provides a little perspective on how the Task Force intends to accomplish its mission:

Task Force Timeline

Task	Timeframe	Progress	Anticipated Outcome
Complete comprehensive practice analysis (PA) survey	July 2016	Survey is in draft form	Survey ALL members of the ARSIG. Goal is 60% or greater return rate.
Review PT & Vet practice acts for all 50 states	Completed	Completed	Summary table of all 50 states. Outcome: Only six (6) states have explicit language allowing PTs to practice on animals.
Summarize current educational programs & educational requirements related to animal rehab for the PT & PTA	By CSM	In Progress	Outline current post entry-level certification/ diploma options and other educational programs in existence leading to competencies for PTs and PTAs to treat animals.
Draft a "White Paper" on animal rehab	July 2016 *Draft a "fact sheet" by August 2015.	Cannot be fully completed until "after" the Practice Analysis is completed.	Completed a preliminary draft "fact sheet" to include comprehensive summary of animal rehab in the United States. Finalize White Paper after completion of Practice Analysis.

California Veterinary Medical Board

By the time you read this edition of *OPTP,* the California Veterinary Medical Board (VMB) may have already held a public hearing on the proposed regulatory language to mandate "direct supervision" over PTs. The current timeline is for a July/ August public hearing, "if" the Board effectively notifies the public 45 days in advance.

To re-emphasize, if the VMB succeeds in their goal to limit the ability for PTs to practice on animals through regulatory language, then all PTs and PTAs in California will be negatively impacted. I am not sure how best to articulate the problem in

CA if regulations are passed other than to say that PTs and PTAs will be treated more like "techs" when treating animals, garnering a significant lack of respect for the level of education and competence therapist's possess. Given all that the PT profession has strived for over the past 15 to 20 years to gain respect as a valuable asset to the health care team in human medicine, the proposal under review by the CA VMB would be a setback in that aspect of animal care.

The Dilemma of Term and Title Protection

The use of Term and Title for PTs treating animals has been a source of some debate. Generally speaking PTs can use the term "Physical Therapy" and title of "Physical Therapist" when treating animals "*if*" respective PT scope of practice language includes animal rehab as part of practice. If, however, the laws regulating PT practice are limited to humans, then using the term physical therapy when treating animals becomes blurred. In this case, the best recommendation is to use the phrase "animal rehabilitation."

If the Physical Therapy Practice Act in a state jurisdiction has explicit language that protects the term, "Physical Therapy" and title, "Physical Therapist Assistant," then generally the law applies to all non-PT health professionals. Therefore, veterinarians who provide rehab care to animals should not call their services "physical therapy" nor claim that they are a physical therapist when treating animals. When in doubt, questions regarding term and title protection should always be addressed with appropriate professional regulatory boards or Health Departments in respective jurisdictions.

Call for *OPTP* Submissions

To promote, educate, and advance the practice animal rehabilitation, I encourage members to submit articles related to clinical pearls, critiques of recently published articles, unique case studies, or abstracts of primary research. Please contact the President or Vice President of the ARSIG if interested in submitting an article for review.

Sandy Heaven!!

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

VP Report

Stevan Allen, MAPT, CCRT

The ARSIG, in conjunction with the Orthopaedic Section, is pleased to announce our newest addition to the library of Independent Study Courses: **Physical Therapy Examination of the Equine Patient**. The monograph provides comprehensive coverage of examination procedures and progressive rehabilitation of the equine patient. In addition, several clinical case studies are included to enhance learning. Written by Arlene White, PT, M. Anim St. Physiotherapy and Melissa King, DVM, PhD, experienced authors in the field of equine rehabilitation, this is a must read for those practicing or conducting research with equine clients.

Also available is the two set series, PT Evaluation of the Animal Rehabilitation Patient (Canine). The first monograph was written by Lisa Bedenbaugh, PT, CCRT, and Evelyn Orenbuch, DVM CAVCA, CCRT: PT Evaluation of the Animal Rehab Patient and Michael R. Lappin, DVM, PhD, DACVIM is the author of the second monograph: Zoonosis and Animal Rehabilitation. These two monographs present animal rehabilitation for the canine population. The importance of using clinical reasoning skills to guide the assessment for each animal patient is emphasized. Also, a team approach to rehabilitation of the animal patient is highlighted, along with specific treatment intervention strategies. A companion monograph covers recognition of the clinical signs of disease in humans and animals that are associated with zoonotic diseases. Implementation of proper infection control and intervention is a focus. Case studies are provided for each of the monograph. We are confident that these two monographs will be an excellent addition to your reference library. You can order both on the Orthopaedic Section Website at http://www.orthopt.org/content/education/available_independent_study_courses.

IAPTAP
International Association of
Physical Therapists
in Animal Practice

Lin McGonagle, MSPT, LVT
Lin@AnimalPTCenter.com

Many national associations have formed in the past 15 years for practitioners interested in treating animals, including our own Animal Rehabilitation Special Interest Group (SIG), under the Orthopaedic Section of the APTA. Similar to our grassroots efforts, other physical therapists and physiotherapists throughout the world have been active in the process of gathering support to be recognized by their parent associations. The World Confederation of Physical Therapy offers a way for therapists with a passion for helping animals to organize within a subgroup and establish more open communication on an international level. Leadership from several SIGs across the globe worked together to meet the requirements for application to form an international subgroup, and the IAPTAP was subsequently recognized within WCPT in 2011.

There are currently 10 member countries that belong and support the international subgroup: Australia, Canada, Finland, Germany, Ireland, South Africa, Sweden, Switzerland, the United Kingdom, and the United States. Our goals are to encourage high standards of physical therapy education, research, and practice; to encourage communication and information exchange; to promote research and evidence-based practice; to assist WCPT member organizations in developing animal special interest groups, and to foster collaborative relationships with other health professionals and professional groups to improve animal health and welfare.

Each member country is represented on the Executive Board and volunteers serve for 4-year periods. I have had the honor of representing the Animal SIG within IAPTAP these past sev-

eral years. We "meet" periodically via email and have worked together to write the constitution and bylaws and select a logo. We are currently focused on expanding the website, creating a newsletter, and gathering functional outcome tools to share.

The founding IAPTAP President is one of our own long-term members and former SIG Vice President, Steven Strunk. The Vice President of IAPTAP is Donna LaRocque from Canada. Our Treasurer is Brigitte Stebler from Switzerland. Our incoming IAPTAP President is Ansi Van Der Walt from South Africa. Ansi qualified as a physiotherapist from the University of Pretoria in 2001. She obtained her MSc Physio from the University of Witwatersrand in 2010. Ansi is actively involved in the treatment of both horses and dogs and competes in both equestrian and canine sporting events.

You are welcome to reach out to any of the IAPTAP officers or the member country representatives with your ideas, questions, or concerns.

Ansi Van Der Walt ansi@equibalance.co.za

Donna LaRocque devonpt@telus.net

For more information regarding this group, visit their website at www.wcpt.org. Under the drop-down menu of subgroups, choose "animal practice."

Tendinopathy - Literature Review & PT Management of the Canine Patient

The following is an edited excerpt from a research study entitled, *"Rotator Cuff Tendinopathy in a Wheaten Terrier: A Physical Therapy Case Report"* by Amie Lamoreaux Hesbach, tDPT, CCRP, CCRT. The study was part of required dissertation for Dr. Hesbach's Doctorate Degree in Physical Therapy.

Tendinopathy in the canine patient is a complicated and often difficult pathology to treat. Dr Hesbach provides a comprehensive overview of the condition, in addition to common clinical signs and symptoms, followed by suggested treatment interventions for the canine patient.

[Contributions to this article were provided in the Introduction, the addition of figures/photos, and narrative edits to the original manuscript to meet publication guidelines by Kirk Peck PT, PhD, CSCS, CCRT]

CANINE TENDINOPATHY

Amie Hesbach, tDPT, CCRP, CCRT

Clinical Presentation of Tendinopathy

Forelimb lameness associated with supraspinatus tendon injuries is described as mild to moderate, usually in medium to large adult dogs, and often present bilaterally (though rarely is lameness observed bilaterally).[1] The patient's lameness is described as insidious, without known traumatic incident, chronic in nature, and lameness that worsens throughout the day, even with minimal to moderate activity.[1] Tendinopathy may also lead to more pronounced lameness after heavy exercise or exertion.[2] In addition, the client might report that the pet is often reluctant to jump down or descend stairs.[3]

Physical examination of a patient with supraspinatus tendinopathy will reveal pain with direct palpation over the supraspinatus tendon and greater tubercle (Figure 1), objective muscle atrophy, and pain or spasm with shoulder extension and abduction.[4] Pain or spasm upon shoulder flexion while stretching the biceps brachii tendon (eg, shoulder flexion with elbow extension) suggests involvement of the biceps brachii.[1,2] Of interest, Canapp et al[2] found that 94.5% of canine patients had biceps brachii involvement in combination with supraspinatus tendinopathy.

Diagnostics

In canine patients with localized pain to the shoulder joint, medical imaging with radiographs, diagnostic ultrasound (US), and/or magnetic resonance imaging (MRI) might prove beneficial. These imaging studies will help ascertain whether the source of discomfort is from the elbow, shoulder, or cervical spine. On radiographic evaluation, supraspinatus tendon degeneration might present with subtle calcification located cranial and medial to the greater tubercle. This is distinguished from biceps brachii tendinopathy, which has characteristic calcification present caudal to the intertubercular groove, closer to the humeral head.[1] In addition, alterations at the supraspinatus tendon insertion with mineralization (with or without impingement of the biceps brachii tendon) are apparent on MRI in the canine patient with tendinopathy.[2]

Evaluation of tendinopathy using diagnostic US will reveal alterations in shape (concavity), size (enlargement), and echogenicity at the tendon (Figures 2 and 3). Fiber patterns are often irregular in appearance, while full-thickness tendon tears present with tendon fiber retraction.[2]

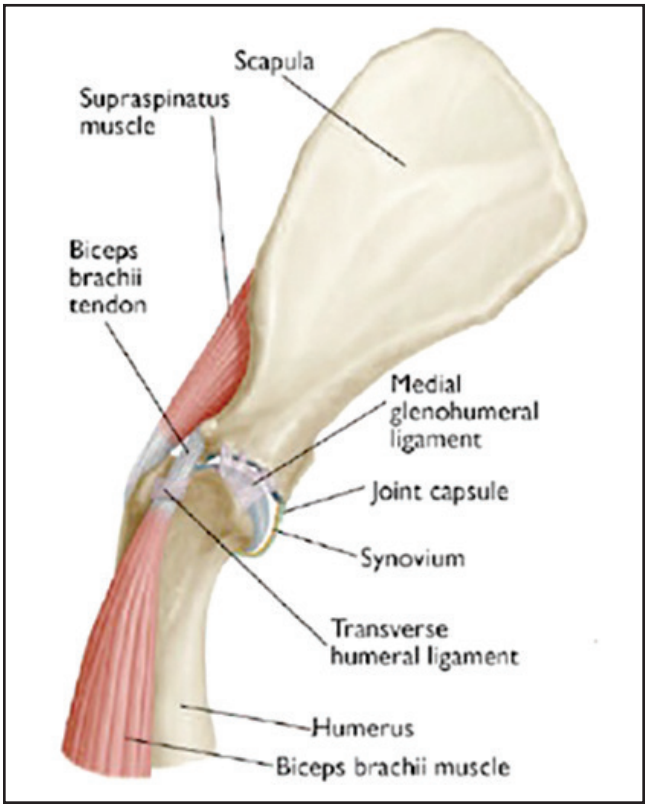

Figure 1. Canine shoulder anatomy.

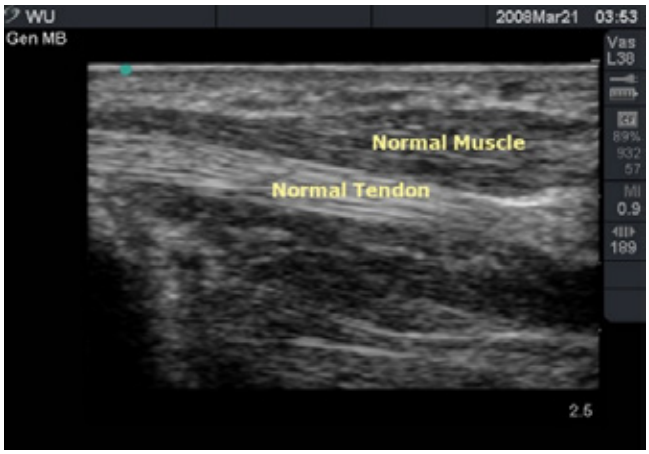

Figure 2. Normal tendon – diagnostic ultrasound.

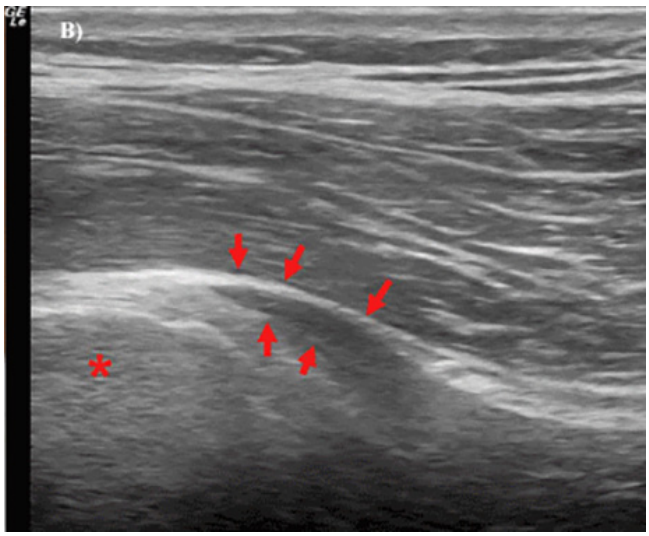

Figure 3. Arrows indicating site of tendinopathy.

Evaluation of the Tendinopathy Patient

Evaluation of the canine patient with suspected or diagnosed supraspinatus tendinopathy includes subjective and objective data, both of which are assessed at initial presentation and reassessed throughout the progression of rehab. Patient data collected as part of physical therapy examination includes: client history and report; subjective client rating scales of function and pain (Helsinki Chronic Pain Index (HCPI) and Canine Brief Pain Inventory (CBPI); goniometric measurement; girth assessment—as an indirect measure of strength; functional mobility and gait evaluation, including lameness scales/scores; and client description of functional limitations and disability.

Goniometry is a reliable and objective method for determining range of motion of joints in healthy dogs, though through clinical experience, there is some variation between and among breeds.[5,6] Of greater priority to the clinician is the ROM required by specific joints during functional activities, such as walking, trotting, stair climbing, and jumping. In addition, girth measures, or anthropometric assessment of limb circumference, may be used as an indirect measure of strength and muscle mass.

Though difficult to quantify, assessment of gait and functional mobility is integral to the development of a physical therapy plan of care and determination of applied interventions. Description of patient strategies for functional mobility, especially in absence of kinematic analysis, might demonstrate limitations in ROM, flexibility, muscle force production, and motor control. In addition, the patient should be evaluated during transitions of movement (eg, rising from lying to sitting to standing and reverse), ambulation (eg, walking, trotting, and galloping) and functional postures (eg, postures for eating/drinking and urinating/defecating), and movements (eg, stair climbing, jumping into a vehicle or onto a bed or couch) to further assess biomechanical strategies, abilities, and disabilities. The therapist may then determine which muscles are weak or painful based on anatomy and biomechanics, and through observation of movement strategies used by the canine patient. Lameness scores, though only representing a numerical value of a subjective descriptor, are widely used in veterinary medicine and represent a method of communication with other members of the veterinary medical team (Table 1).[7] Therefore, lameness scores should be included as part of a routine examination.

Treatment Strategies for Tendinopathy

Physical therapy treatment strategies typically focus on mechanisms of injury with a goal to promote healing of damaged or degenerated tissues and avoid exacerbations. The EdUReP model addresses tendinopathy through *education*, periods of tendon *unloading*, controlled tendon *reloading*, and *prevention* strategies, including client education on anatomy, etiology, and "self"-management skills.[8]

Supraspinatus tendinopathies in the canine patient have historically been nonresponsive to traditional treatment with NSAIDs, intraarticular steroid injections, and rest (or controlled activity).[2,3] Use of radial extracorporeal shockwave therapy (rESWT) and regenerative medicine have demonstrated some positive results when used in conjunction with PT.

Goals of PT for patients with tendinopathy include: manage pain, reverse the disease progression at the level of the pathology, protect the tendon from repeated trauma or exacerbation, restore normal biomechanics, progressively strengthen the stabilizers, incorporate eccentric contractions,[4] return to previous levels of activity uninhibited by symptoms or impairments, prevent disease recurrence, and enable the client to manage the patient's condition independently.[8]

Manual therapy for tendinopathy may also be indicated for the canine patient if joint restrictions are noted as part of the biomechanical evaluation. Manual therapy serves to restore normal joint function and reduce areas of impingement that may be a source of pain and dysfunction. Modalities, incorporated early in the PT regimen for management of pain, also contribute to improved health and potential repair of injured tissues.

Table 1. Lameness Scores[7]

Lameness score (5)	Descriptor
0/5	Normal
1/5	Slight, intermittent lameness
2/5	Obvious weight bearing lameness
3/5	Severe weight bearing lameness
4/5	Intermittent nonweight bearing lameness
5/5	Continuous nonweight bearing lameness

Education of the client in understanding the need for activity modification, restrictions, and relative rest is integral to patient recovery. Tendon unloading, through relative rest, behavioral modification, and the use of more efficient movement patterns will help the patient avoid fatigue in and further damage to weakened tissues. Controlled reloading is accomplished through guided introduction of body weight supported activities progressing to resisted movements to encourage increased dynamic stabilization and eccentric muscle contractions. Successful rehab will enable the canine patient to participate in high level functioning activities that require core stabilization, dynamic balance, and gait on uneven surfaces (Figure 4).

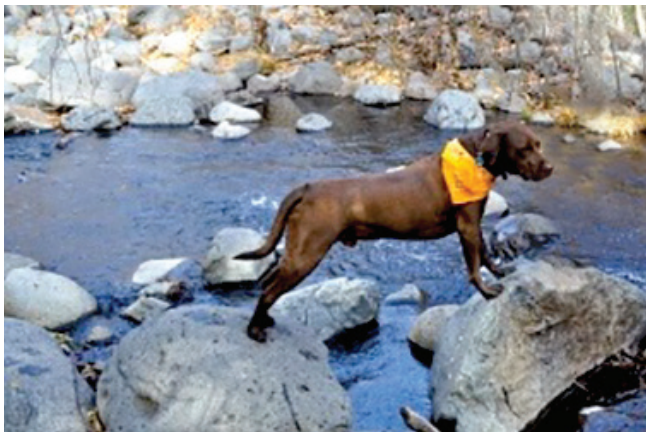

Figure 4. Dynamic stability on uneven terrain.

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Another Successful Annual Orthopaedic Section Meeting Held in Phoenix

The 2015 3rd Annual Orthopaedic Section Meeting in Phoenix, Arizona, highlighted the physical therapist's role in the rehabilitation of lower extremity injuries and impairments of the hip, knee, and ankle through an active learning environment, small group discussions, and hands-on labs.

Industry experts in manual therapy, biomechanics, movement science, regenerative rehabilitation, sports injury analysis, orthopaedic surgery, radiology, stem cell research, ACL reconstruction rehabilitation, and rheumatology addressed various lower-extremity dysfunctions commonly seen in orthopaedic practice. In addition, meeting participants received great information regarding curriculum resources available to facilitate the development of orthopaedic residency programs. Throughout the conference, attendees engaged in active learning sessions with colleagues while enjoying the luxurious amenities and atmosphere provided by the beautiful Arizona Grand Resort and Spa in lovely Phoenix, Arizona.

Following section breakout sessions, attendees shared their thoughts about the Annual Meeting:

"Every year I enjoy attending CSM, but it is often challenging to dialogue with presenters because of the large crowds. Therefore, I prefer the intimate setting of the annual orthopaedic section meeting."

"It was great to speak with other academicians to discuss future research collaboration opportunities."

"I received great career advice, and connected with a potential faculty mentor. It was great to reconnect with friends, clinical mentors, and colleagues in orthopaedic practice."

"The hands-on portion of the breakout sessions was phenomenal; I received great feedback from orthopaedic experts regarding patient handling techniques."

As the Orthopaedic Section continues to grow and expand this Annual Meeting, we will continue to assess and measure feedback from attendees and Section members to provide quality continuing education to advance clinical practice. We would like to thank all of the presenters, exhibitors, and attendees for making this event a great success! If you missed out this year, please mark your calendars for May 5-7, 2016, for the 4th Annual Orthopaedic Section Meeting in Atlanta, Georgia.

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Golf Injuries:

Prevention & Management

An Independent Study Course Designed for Individual Continuing Education

Independent Study Course 25.2

Course Description

This 3-monograph series will educate the registrant on the kinesiology of the golf swing, injury prevention strategies, and comprehensive rehabilitation program design. The authors have exceptional backgrounds and experiences in treating the golf athlete. Each monograph is designed for the registrant to be able to immediately apply the content to patient care. In addition to the written work, one author has created a library of video clips showing numerous exercises that can be used at various stages of rehabilitation.

Topics and Authors

- **Kinesiology and Biomechanics of the Golf Swing**
  Ada Wells, MPT, PMA®-CPT, TPI-Level 3 Medical
- **Strength & Conditioning for Golf Injuries**
  Brandon Schomberg, DPT, OCS, SCS, CSCS, CGFI-MP3
- **Common Golf Injuries**
  Steven Pavlet, PT, DPT, MS, OCS, ATC

Continuing Education Credit

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

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

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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:

- Cite the incidence and prevalence of common injuries of the golfer.
- Identify the postures, mechanics, and pathomechanics associated with the golf swing.
- Identify common golf injuries according to etiology and body region.
- Develop intervention strategies to minimize golf injuries.
- Identify key elements during each phase of the golf swing motion, including grip, address, backswing, downswing, impact, and follow through.
- Identify the kinematic requirements of the critical body segments during each phase of the golf swing.
- Identify at least 3 examples of different swing styles based on differing body types.
- Identify and differentiate between efficient and faulty swing characteristics.
- Describe how the stretch-shorten cycle and ground reaction forces contribute to maximum club head speed at impact.
- Describe which phases of the golf swing motion increase the torsion, compression, and shear in the lumbar spine.
- Identify stress potentials in the upper and lower extremities during the golf swing.
- Apply knowledge of the golf swing to assist in designing rehabilitation programs and improving performance.
- Apply evidence-based strength and conditioning concepts to assist golf athletes of all skill levels with injury prevention and improved golf performance.
- Appreciate the role of the neuromuscular system in generating an optimal golf swing.
- Explain general timelines, precautions, and contraindications for safely returning to golf.
- Apply clinical screening tools for functional analysis of the golfer and assist in developing injury prevention programs and proper golf warm-up routines.

For Registration and Fees, visit orthopt.org/content/c/25_2_Golf_Injuries

Additional Questions—Call toll free 800/444-3982

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