ORTHOPAEDIC

Physical Therapy Practice

THE MAGAZINE OF THE
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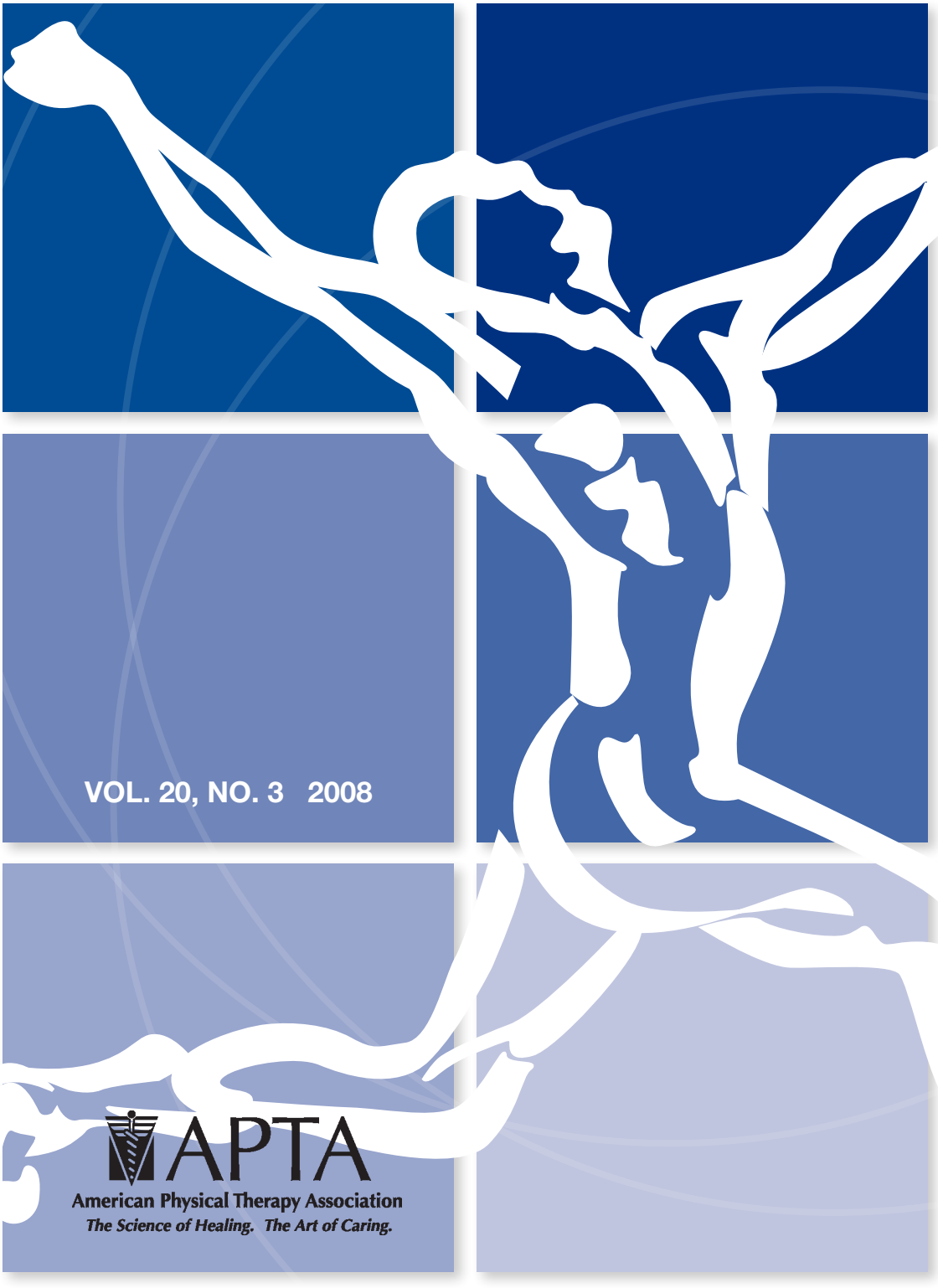

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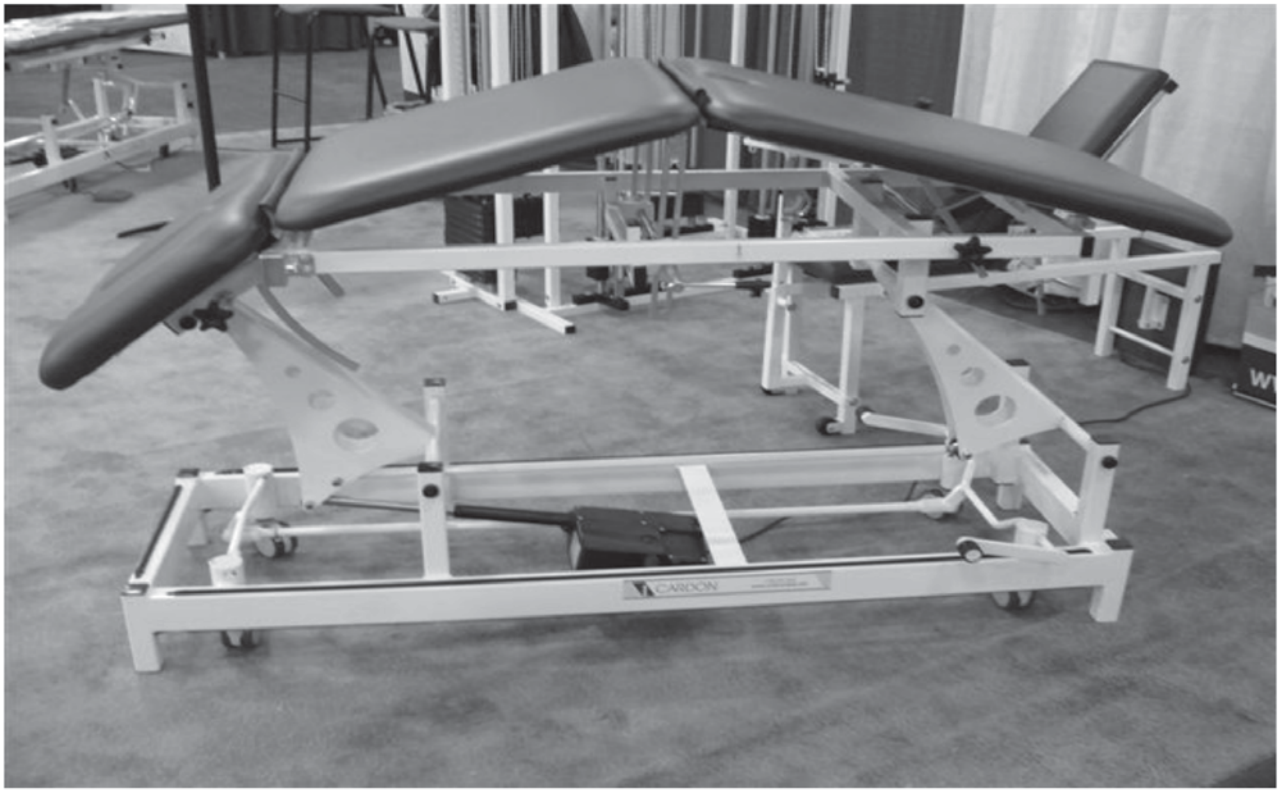

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ORTHOPAEDIC

Physical Therapy Practice

VOL. 20, NO. 3 2008

inthisissue

regularfeatures

optpmission

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

publicationstaff

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Christopher Hughes, PT, PhD, OCS
Editor, OP

A Call for Faculty-Student Papers

Many PT programs offer students an opportunity to conduct or collaborate with faculty on research during their education. Each PT program has various degrees of involvement from small scale projects to working with faculty on grant-funded research. Exposing students to the research process is a vital part of a doctoring profession and ideally will help establish a well-grounded, evidence-based approach to patient care.

In this regard, I would like to formally present an opportunity to all PTA and PT programs that are involved in faculty-student research. At *Orthopaedic Physical Therapy Practice (OP)*, we intend to serve as another outlet for presenting collaborative faculty-student publication efforts that represent the best-of-the-best from PT programs across the country.

Many times excellent faculty-student projects end prematurely by soley meeting requirements for a research course and possibly presenting at a university's local research symposium. I am sure some of this work would be of interest to our readers. If you are a faculty advisor or a clinical instructor and feel that efforts by your student have further merit, we would like you to consider dissemination beyond the university level and submit to *OP*. Some of the best articles in past issues of *OP* have been published by students under faculty advisement. I think this speaks volumes for the coordinated effort and dedication by students and faculty to go one step further to share their work. Of course other avenues exist for submitting to peer-reviewed publications. At *OP*, it is not our intent to compete with this process.

Our editorial structure is not the same. However publishing in *OP* is unique in that we can foster a "friendly" competition among programs by having each program "claim an issue" and bundle their publications effort in a single issue. We have some ideas on how to best credit a program's efforts. For example, we plan to offer complimentary student memberships to the university that submits the best articles.

So what needs to be done to participate? First we can only handle 5-6 papers an issue so I envision a faculty/clinicians screening committee within PT departments that could vote on which papers get submitted to *OP*. We want the best work that each program can offer so as to epitomize that program's efforts in faculty student research. All work ideally will be submitted collectively so as to present all papers from the same university in one issue.

The topics for the papers will be similar to all articles submitted to *OP*. Topics can include case reports, literature reviews, RCTs, or other traditional research designs involving small or large data sets. Since we are a clinically focused publication we prefer topics that involve patients and have a strong clinical focus. The best scenarios usually involve the generation of case reports while students are on their affiliations. This will allow students to apply evidence-based techniques and also work closely with their CI and faculty advisors in applying their research skills to the clinical setting. All submissions must adhere to guidelines for authors found on the website at:
https://www.orthopt.org/downloads/op_instructions_to_authors.pdf.
Our upcoming deadlines for submission are: August 29, November 28, and February 20, 2009.

Even though we will be conducting this initiative, we will still be maintaining are open invitations to all interested authors in submitting an article relevant to the mission of *OP*. I am looking forward to these submissions! If you have any questions, please contact me.

RESIDENCY UPDATE CORNER

Tara Jo Manal, PT, DPT, OCS, SCS

The Orthopaedic Section residency Committee is interested in active members to advance 3 major initiatives. We are working to increase the number of residency training programs in Orthopaedics across the country. There are available openings in working groups focusing on each of the following 3 areas: developing programming for Residency and Fellowship programs, training residency and fellowship faculty, and growth in marketing in residency activities. We are looking for a diverse group willing to work towards these goals. To join, please e-mail Tara Jo Manal at Tarajo@udel.edu.

The How-to-Guide to Develop and Manage and Orthopaedic Residency Program is a pre-conference course planned for CSM 2009 in Las Vegas. This course will provide the practical knowledge and resources you need to prepare you to start your residency program in Orthopaedics. If you wish you could get a program going, this course is for YOU! Sign up and join us.

CSM 2009
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Orthopaedic Section Pre-conference Courses

Call the Orthopaedic Section office or visit us online for more information!
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2-Day Courses:

SUNDAY, FEBRUARY 8 –
MONDAY, FEBRUARY 9, 2009

INTRODUCTION TO MANIPULATION AND EXERCISE FOR THE THORACIC SPINE AND RIB CAGE

Description: The use of high velocity low amplitude(HVLA) or manipulation techniques is becoming the standard for entry level clinicians throughout the country. This course is designed to update clinicians, clinical instructors and faculty members to feel confident using and instructing these extremely high yield techniques.

The objectives of this course include providing a framework for clinical decision making along with the interventional skills required to successfully utilize manual therapy for the thoracic spine and rib cage in clinical practice. This course will heavily emphasize lab and the development of psychomotor skills so you can utilize these techniques with confidence on the first day back in clinic. Current evidence that guides interventions will be reviewed to allow the participant to effectively utilize the interventions most likely to be of benefit for a particular patient. Of special interest is recent evidence on the effectiveness of manipulation of the thoracic spine for patients with cervical disorders. Best practice recommendations, lab demonstration and practice for the following evidence based interventions will be included:

1. Lower, Middle and Upper Thoracic high velocity low amplitude (HVLA) thrust manipulation;
2. Muscle Energy Technique for Rib dysfunction and inhalation/exhalation restriction;
3. Impairment based therapeutic exercise for the upper quarter focusing on improving scapulothoracic motion;
4. Exercise integrating thoracic and scapulothoracic therapeutic exercise and neuromotor re-education with cervical and lumbar spinal stabilization techniques.

EVALUATION AND MANAGEMENT OF CERVICOGENIC HEADACHE

Description: This course will discuss the pathophysiology, classification, and current evidence for differential diagnosis and management of cervicogenic headache from other common forms of headache. Examination procedures will be discussed, demonstrated, and practiced to include:

1. Typical symptom presentation,
2. Provocation testing and local mobility testing for the upper and lower cervical spine and upper thoracic regions.

Current evidence for the management of cervicogenic headache will be presented and include discussion, demonstration, and practice of selected joint mobilization/manipulation, exercise, and self management techniques.

VISION 2020 ACTUALIZED IN THE ONSITE OCCUPATIONAL HEALTH SETTING

Description: Applicable to all occupational health settings, this seminar teaches physical therapists advanced clinical methods for determining movement impairment diagnoses and recognizing co-morbid medical conditions prior to their escalation into costly pathological conditions. Using the International Classification of Function, and the Nagi Model of Disablement, the content knowledge and process skills necessary to enhance physical therapists' labeling of differential classifications of movement impairments and functions as essential to early and effective interventions to prevent impairments from progressing toward a recordable pathology will be emphasized. Within the context of a collaborative occupational health paradigm, advanced patient examination, medical screening and evaluation competence will facilitate physical therapists clinical judgments regarding when to intervene, and when to refer and how to best implement evidenced based guidelines and therapeutic measures.

Until now, physical therapists have lacked widely accepted clinical and medical screening guidelines or decision rules that would decrease the use of unnecessary referrals and tests. The implementation of contemporary medical screening guidelines assures both clients and practitioners less risk without compromising care and thereby reducing costs to the employer. This conference will include education and lab sessions to explore current evidence based guidelines and assure physical therapists that they are following best practice rules and algorithms as related to case scenarios frequently encountered in occupational health practice settings.

1-Day Courses:

MONDAY, FEBRUARY 9, 2009

PEARLS & PERILS FOR THE MANAGEMENT OF INDIVIDUALS WITH FOOT AND ANKLE PATHOLOGIES: MANUAL THERAPY, TAPING, AND FUNCTIONAL EXERCISE.

Description: The evaluation and management of common foot and ankle conditions will be addressed in this one day "hands-on" lab course. Manual therapy, taping techniques, and functional exercises will be presented for leg, rearfoot, midfoot, and forefoot conditions. Anatomical, biomechanical, and supporting evidence will also be integrated throughout lecture and lab presentations. This course will provide physical therapists with useful clinically relevant information that can be immediately applied into every practice.

THE HOW-TO-GUIDE TO DEVELOP AND MANAGE AN ORTHOPAEDIC RESIDENCY PROGRAM

Description: The Orthopaedic Section of the APTA has adopted an initiative to promote the expansion of residency training programs in Orthopedic Physical Therapy. Outpatient orthopedic physical therapy clinics are encouraged to explore the value added benefit of residency training on site. Training the next generation of clinical specialists in the area of orthopaedics is a way to contribute to the profession and raise the level and profile of your practice. This pre-conference course will review all the necessary components to the successful development of Residency Training in your clinic. The breadth and depth of material covered will apply equally to those contemplating the idea and to those fine-tuning their application for credentialed status.

Section Members In the News

2008 HONORS & AWARDS CEREMONY

Many association leaders, physical therapists, and physical therapist assistants gathered at the 2008 Honors and Awards ceremony during the Annual Conference and Exposition in San Antonio, TX to honor and thank their colleagues for the contributions and commitment to practice, research, and education.

Congratulations to the following Orthopaedic Section members who were some of this year's recipients:

Catherine Worthington Fellows
- Donald Neumann, PT, PhD, FAPTA
- Jessie Van Swearingen, PT, PhD, FAPTA

39th Mary Mc Millan Lecturer
- Anthony Delitto, PT, PhD, FAPTA

Lucy Blair Service Award
- Jerry L. Klug, PT

Henry O & Florence P Kendall Practice Award
- Susan D. Ryerson, PT, DSc

Eugene Michels New Investigator Award
- Samuel R. Ward, PT, PhD

Marian Williams Award for Research in Physical Therapy
- Richard K. Shields, PT, PhD, FAPTA

Helen J. Hislop Award for Outstanding Contributions to Professional Literature
- William Boissonnault, PT, DHSc, FAAOMPT

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- Julie M. Whitman, PT, DSc, OCS, FAAOMPT
- Cameron W. MacDonald, PT, DPT, GCS, OCS, FAAOMPT
- John D. Childs, PT, PhD, MBA

Jules Rothstein Golden Pen Award for Scientific Writing
- Richard W. Bohannon, PT, EdD, DPT,NCS, FAPTA, FAHA

Margaret L. Moore Award for Outstanding New Academic Faculty Member
- Deydre S. Tehyn, PT, PhD, OCS

Mary McMillan Scholarship Award – Professional Education Level
- Christina Lapp Holladay, SPT, MA, CSCS
- Valerie J. Williams, SPT

Minority Scholarship Award for Academic Excellence–PT Students
- Sean D. Johnson

Developing a Physical Therapy Diagnosis for a Patient with Upper-extremity Paresthesia: A Resident's Case Problem

Trevor Lentz, PT, CSCS [1]
Marty Huegel, PT, MEd [2]
Mark Bishop, PT, PhD [3]

ABSTRACT

Study Design: Resident's Case Problem.

Background: A 58-year-old male with insidious onset of unilateral upper extremity paresthesia in the lateral border of the right hand.

Diagnosis: Historical findings led us to establish a differential diagnosis that included cervical radiculopathy (CR), carpal tunnel syndrome (CTS), and thoracic outlet syndrome (TOS). The examination battery included tests and measures that provided the strongest changes in post-test probability for each of the conditions in the differential diagnosis. A clinical prediction rule (CPR) developed for the diagnosis of cervical radiculopathy was also used. Negative findings on tests for TOS reduced the post-test probability that this condition was present to 7.5%. Post-test probability for CTS was reduced to 23%. The finding of 3 out of 4 tests on a prediction rule for CR resulted in the greatest change in which the post-test probability increased to 65%. Based on the greatest change in post-test probability, we concluded that the most likely source of the symptoms was cervical radiculopathy.

Discussion: The diagnostic process is one of the most challenging aspects of patient care in the rehabilitation setting. Upper extremity paresthesia may be related to a number of different pathologies. Intervention for each pathology is unique, and an accurate examination and evaluation is critical to establishing an effective plan of care. Emphasis in this case was placed on determining the change in probability that a condition was present. Changes in post-test probabilities as a result of clinical tests may be used in the clinical setting to establish a diagnosis.

Key Words: *cervical, clinical prediction rule, differential diagnosis, post-test probability, radiculopathy*

BACKGROUND

Diagnosis represents 1 of the 5 elements of the patient management model, according to the APTA *Guide to Physical Therapist Practice.*[1] The intent of this model is to optimize patient outcomes and establish a standard of practice across clinicians. The diagnosis component of this model is one of the most critical, yet challenging aspects of patient management. Delitto and Snyder–Mackler,[2] as well as Fritz and Wainner,[3] more recently have reported on the lack of research in the rehabilitation literature focused on elucidating the diagnostic process, particularly in an evidence-based format.

Clinical decision-making regarding diagnosis in the field of physical therapy has traditionally relied on practice bias, prior experience, and anecdotal evidence.[4] Edwards et al[5] reported on 2 common models of clinical reasoning rooted in the empirico-analytical research paradigm: pattern recognition and hypothetico-deductive reasoning. In contrast to the pattern recognition model, which relies on practitioner experience and skill to recognize pathological signs and symptoms, the hypothetico-deductive model states that clinicians formulate a hypothesis based on initial interview or examination.[5,6] The hypothesis is then confirmed or refuted based on objective measures. While most experts concede that both approaches are used at different times in the diagnostic reasoning process, experienced clinicians tend to employ a pattern recognition approach, whereas inexperienced clinicians or experienced clinicians faced with an unfamiliar condition, favor a hypothetico-deductive approach.[6-8]

For the experienced and inexperienced clinician alike, distinguishing among distinct pathologies that present with similar symptoms can be challenging. An accurate diagnosis is critical, as interventions may be drastically different and targeted towards different anatomical regions. In these circumstances, a pattern recognition approach may be inconclusive or provide an inaccurate diagnosis. The presence of paresthesia in the upper extremity is one example of a symptom that has been attributed to different pathologies.

Paresthesia, or an abnormal sensation such as "pins and needles" or tingling,[9] is a neurological symptom commonly encountered in the outpatient orthopaedic population.[10] It most commonly occurs when pressure is applied to an injured nerve trunk, and may be caused by a number of neurological, biochemical, and musculoskeletal conditions.[11,12] Distinct and unique anatomic structures are implicated for each condition, and treatment for each is directed toward different anatomical regions. Hence, a correct diagnosis is important in order to avoid unnecessary, prolonged, and potentially detrimental treatment. Conditions common to the orthopaedic setting that may cause paresthesia include cervical radiculopathy (CR),[13] carpal tunnel syndrome (CTS),[14] and thoracic outlet syndrome (TOS).[15] A thorough review of these pathologies is beyond the scope of this manuscript, but can be found elsewhere in the literature for interested readers.[19,12-21]

Distinguishing among these conditions requires accurate and reliable clinical tests, as well as the proper interpretation of test results. Imaging studies and electrophysiologic tests, such as magnetic resonance imaging (MRI) and nerve conduction velocity tests, respectively, have traditionally been the "gold standard" for diagnosis of these conditions in medical practice.[1,18,19,22] However, these studies are expensive, impractical, and are often not predictive of impairments, functional limitations, or disabilities.[12] In the medical field, clinical prediction rules (CPR) have been developed in an effort to control

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health care costs by decreasing reliance on imaging studies for the determination of a diagnosis. Clinical prediction rules are evidence-based decision-making tools that use a combination of clinical findings to predict a condition or outcome as a result of intervention.[4,24] Childs and Cleland[24] have described CPRs as decision-making surrogates for more expensive diagnostic tests.

Clinical prediction rules consist of a cluster of individual clinical tests which are used to determine changes in probability, and may be used to predict existence of a condition or outcome following intervention.[4,25] These tests, when combined as a cluster, provide higher levels of sensitivity and specificity than individual clinical tests alone. The components and development process for CPRs have been well-documented in the literature.[24-28] The most clinically useful CPR is that which provides the most significant difference between pre- and post-test probability. These statistical probabilities facilitate informed decision-making and may guide intervention strategies.

Clinical prediction rules, while already used in the medical field, have recently become more common in the practice of physical therapy.[24] The development of such tools has been undertaken in an effort to improve and standardize the process of clinical decision making; however, few validated CPRs pertinent to the practice of PT currently exist.[29] Childs and Cleland[24] have described a method for the development of CPRs in the practice of physical therapy. McGinn et al[28] have published a hierarchy of validation for clinical prediction rules.

Several CPRs have recently been published in the physical therapy literature for use in clinical practice.[21,29-31] Areas of clinical uncertainty, such as the diagnosis of the conditions listed previously, benefit most significantly from prediction rules. Recently, a clinical prediction rule has been developed, though not yet validated, for the diagnosis of cervical radiculopathy.[21]

These rules, while not yet widely incorporated into clinical practice, facilitate clinical decision-making.[24] The diagnostic capability varies among objective tests and results must be interpreted with careful attention to the ability of the test to identify and distinguish among pathologies. In the absence of an established CPR, clinicians may use positive and negative likelihood ratios in order to better interpret the diagnostic value of a clinical test. Likelihood ratios may be calculated for individual clinical exams from their specificity and sensitivity values.[3,32] The use of likelihood ratios to determine change in probability has been reported in the literature.[3,32] This provides the clinician with a quick and useful method to determine change in probability based on single test results. Large changes in probabilities from pretest to post-test indicate more clinically significant results. A nomogram is a readily available clinical tool which provides a graphic representation of changes in probability.[33]

The purpose of this case study is to describe the examination and diagnosis of a patient with unilateral upper extremity paresthesia, with a brief description of intervention and outcome. Emphasis is placed on determining the change in probability that a condition is present.

HISTORY

The patient was a 58-year-old right hand dominant male who presented to our outpatient physical therapy clinic with a progressively worsening 6-month history of paresthesia in the right hand. His symptoms were limiting his sleep and work tolerance. The sensation was described as a persistent "pins and needles" with occasional shooting pain in the dorsal and palmar aspects of digits 1 and 2. The patient's occupation as a materials salesman required episodes of prolonged driving, sitting, and computer work. Symptoms increased while lying in supine and after prolonged driving or work at the computer.

PAST MEDICAL HISTORY

Magnetic resonance imaging results of the cervical spine from 3 years prior indicated "3 bulging discs in the cervical spine" per patient's recollection of imaging results from physician. Results of a nerve conduction velocity study for the diagnosis of CTS in the right upper extremity 2 months prior were unremarkable by patient report. There was no past medical history of cervical or upper extremity pain of the same nature as the current symptoms. He reported a strain of the left biceps 3 years ago and multiple prior episodes of mild-moderate low back pain. He denied low back pain at time of initial evaluation. He reported no prior episodes of physical therapy for the current condition. The patient also denied "red flag" symptoms including unrelenting pain, night sweats, unexplained weight loss, or history of cancer.

DIAGNOSIS

Patient Examination and Evaluation

A gross screen of shoulder range of motion was performed in order to rule out the possibility of symptoms originating from the shoulder complex. There were no significant differences between available AROM using Apley's scratch test bilaterally.[9] Additionally, range of motion at the shoulder did not reproduce symptoms.

A cervical range of motion evaluation was performed in order to identify positions that increased neurological symptoms. Symptoms of paresthesia in the palmar aspect of the first and second digits of the right hand were mildly exacerbated during cervical extension. Cervical flexion and sidebending to left side decreased symptoms in the right upper extremity. Cervical extension and right sidebending exacerbated upper extremity symptoms. Cervical range of motion was measured with the patient in a short sitting position. Flexion and extension were tested with an inclinometer placed on the external occipital protuberance. For measures of sidebending, the inclinometer was placed immediately anterior to the external auditory meatus, perpendicular to the zygomatic arch. Reliability studies of single inclinometry for cervical ROM have reported mean interexaminer ICC values of 0.85.[34] Cervical rotation was measured with a goniometer using landmarks outlined by Norkin and White.[35] Cervical ROM measures for this patient are listed in **Table 1.**

Given the presence of upper extremity symptoms, a neurological screen, including myotome, dermatome, and reflex testing was performed. All manual muscle testing methods were those described by Kendall and McCreary.[36] Myotome testing of spinal levels C4 through T1 demonstrated no strength deficits when compared bilaterally. Grip strength was tested with the Jamar hand dynamometer (Irvington, NY). Testing setup included using middle grip position on the dynamometer, holding the elbow at 90° of flexion, and taking the average, in kilograms, of 3 maximal grip attempts. Grip strength measured 13 kg on R

and 15 kg on L. Peolsson et al[37] demonstrated intraclass correlation coefficients (ICC) between 0.85 and 0.98 when evaluating the reliability of using hand dynamometry to measure grip strength. Dermatome testing of C4 through T1 was performed using a cotton swab. Decreased sensation to light touch was noted in the palmar aspect of thumb and index finger of the right hand, which corresponded to the distal aspect of the C6 dermatome. Sensation in all other dermatomes was intact and symmetrical bilaterally. Additionally, sharp/blunt sensation was intact and symmetrical bilaterally. Biceps and triceps deep tendon reflexes were tested bilaterally using a reflex hammer. No deficits were noted in these reflexes bilaterally and all were given a grade of 2, or normal.

Palpation of the cervical region, upper extremities, and shoulders were performed to identify areas of tenderness and attempt to reproduce pain symptoms. Tenderness was noted with palpation to the right upper trapezius that produced a localized pain response, however, failed to reproduce the patient's primary symptoms of pain and paresthesia in the right hand. Segmental mobility of the cervical spine was assessed using posterior-to-anterior glides at each level of the cervical spine with the patient in supine. The patient experienced mild tenderness with segmental gliding at the levels of C6 and C7. The glides did not reproduce pain or paresthesia symptoms.

A battery of special tests was performed, including those indicated for the diagnosis of CR by the CPR proposed by Wainner et al.[21] Cervical radiculopathy was tested with the foraminal compression, or Spurling test, and neck distraction test. Two separate Spurling tests were performed. Spurling test- Part A was performed according to the procedure originally outlined by Spurling and Scoville.[38] The patient was seated, the neck side-bent toward the involved side, and overpressure was applied to the patient's head. The patient denied reproduction of radicular symptoms with performance of the Spurling-Part A. Spurling-Part B is a variation of Part A in which cervical extension and rotation to the involved side are combined with side-bending to the involved side before application of overpressure. Spurling-Part B was positive for this patient. Incidentally, the patient also complained of localized pain in the right lower cervical region with both tests. The sensitivity and specificity of the Spurling test has been reported between 30% and 50% and 93% and 94%, respectively.[39] The neck distraction test was performed according to the procedures described by Wainner, et al.[21] The neck distraction test for this patient decreased symptoms of paresthesia in the right hand and was therefore positive.

Two neural tension tests that bias the median nerve, Upper Limb Tension Test A (ULTTA) and Upper Limb Tension Test Band (ULTTB),[21] were performed. Upper Limb Tension Test A consists of sequentially introducing scapular depression, shoulder abduction, forearm supination, wrist and finger extension, shoulder external rotation, elbow extension, and contralateral followed by ipsilateral cervical sidebending. Upper Limb Tension Test B consisted of the patient in supine with the shoulder abducted to 30°. The following were then introduced sequentially: scapular depression, shoulder internal rotation, elbow extension, wrist and finger flexion, and contralateral, followed by ipsilateral cervical sidebending. The patient demonstrated a positive ULTTA and ULTTB in which his symptoms of UE paresthesia were reproduced. Nerve tension tests with a bias for the radial and ulnar nerve were also conducted on this patient.[40] No reproduction of paresthesia or pain was reported, and these tests were therefore negative bilaterally.

Based on the diffuse neurological symptoms often associated with TOS, clinical tests directed toward the diagnosis of TOS were included in the physical exam. Provocative tests for TOS must reproduce neurological symptoms, in addition to producing a diminished pulse in order to be a positive test.[18] Gillard et al[18] evaluated the diagnostic accuracy of various clinical tests for TOS individually and in combination. In that study, all test pairs that included the Adson test were significantly correlated with the final diagnosis and all pairs of tests were more specific than each test alone. The Adson, hyperabduction, and Wright tests were performed according to the descriptions in the study by Gilliard. All 3 tests were negative bilaterally in this patient.

The patient's work conditions and considerable amount of time spent sitting and engaged in repetitive upper extremity movements placed him at risk for developing carpal tunnel syndrome.[19] The patient reported an increase in symptoms while engaged in routine work with his upper extremities. Historically, the gold standard diagnostic test for CTS is the nerve conduction velocity test. However, some authors argue that no true gold standard has been accepted for the diagnosis of CTS.[14,41,42] Furthermore, no individual clinical test alone has been shown to have sufficient accuracy and reliability to make a definitive diagnosis of CTS.[29] Recent literature for CTS suggests that a combination of electrodiagnostic studies and clinical tests provides better accuracy in the diagnosis CTS.[23,29] A limitation of electrodiagnostic testing is that it may not detect transient or mild CTS.[14] Therefore, despite unremarkable results of a prior median nerve conduction velocity study, CTS could not be ruled out and was included as part of the differential diagnosis.

Table 1. Cervical Range of Motion Measurements at Various Time Points During Treatment

Motion	Initial Evaluation	3 Weeks	6 Weeks (discharge)
Flexion	40°	40°	45°
Extension	45°*	45°*	45°
Right Sidebending	30°*	35°*	40°
Left Sidebending	45°	45°	45°
Right Rotation	55°*	55°	60°
Left Rotation	55°	55°	60°

* pain experienced with motion

Common clinical tests for carpal tunnel syndrome include Phalen's,[43] median nerve ULTT,[21]and Tinel's tests.[44] The sensitivity and specificity have been reported at 0.77 and 0.40, respectively. The negative likelihood ratio and positive likelihood ratio for this test were reported at 0.53 and 1.3, repectively.[29] The more severe the CTS, the more likely one is to present with a positive Phalen's test. Validity measures of the Tinel's test have also been reported.[14,29] The Phalen's test and Tinel's test were negative. The results of the median nerve tension tests were previously reported.

EVALUATION AND DIFFERENTIAL DIAGNOSIS

A differential diagnosis was determined based on initial presentation of signs and symptoms. Due to the patient's medical history, lack of red flag symptoms, work-related exposure to repetitive tasks, and subjective complaints, a differential diagnosis including CR, TOS, and CTS was established. Positive and negative likelihood ratios for each TOS and CTS test were calculated. The change in post-test probability for each diagnosis was determined for each positive or negative test result. Likelihood ratios reported by Wainner et al[21] for the CR clinical prediction rule were used to determine change in probability.

The diffuse symptoms often associated with TOS warranted the inclusion of this condition in our differential diagnosis. The Adson test has shown a significant correlation with the diagnosis of TOS.[18] In addition, the combination of the Adson test and a Wright test that reproduces symptoms has a sensitivity and specificity of 0.79 and 0.76, respectively.[18] Both of these tests were negative for symptom reproduction and diminished pulse. Based on symptom description, patient demographics and patient history, we estimated the pretest probability for TOS in our patient to be approximately 20%. Sensitivity and specificity values for the test combination were used to determine a negative likelihood ratio (LR-). The LR- associated with the Adson and Wright test was 0.28. This LR- reduced the post-test possibility of TOS to 7.5% **(Figure 1)**. Given the combination of objective and subjective findings with which this patient presented, we felt comfortable ruling out a diagnosis of TOS.

We then turned to the potential diagnosis of CTS. Upon further neurological evaluation, symptom distribution in this patient was more consistent with a dermatomal, not median nerve distribution. Clinical tests for CTS were negative. The LR- for the Phalen's test was 0.56. A pretest probability for CTS in a similar population sample was reported as 34%.[29] Therefore, the post-test probability for CTS was reduced to 23% **(Figure 2).** The predictive abilities of the electrodiagnostic and clinical tests for CTS vary in the literature.[14,29] While a change of 11 percentage points was observed in this case, the poor predictive quality of the individual clinical tests

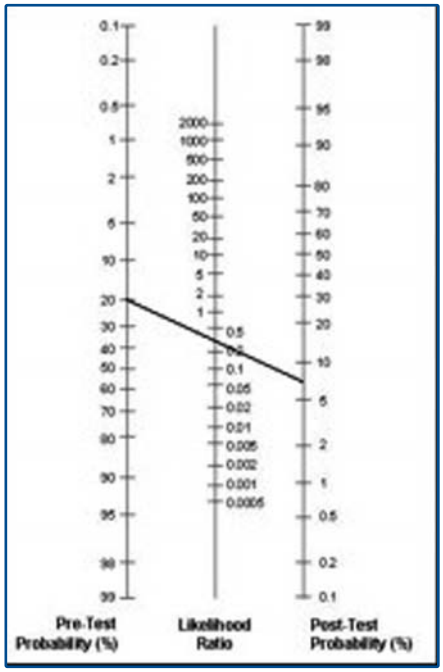

Figure 1. Nomogram depicting the post-test probability estimate for the diagnosis of Thoracic Outlet Syndrome.

preclude us from excluding CTS as a possible diagnosis. These tests may not be sensitive enough to detect CTS in its mildest forms, such as with a conduction block associated with neuropraxia.[14] It is unlikely, however, that CTS would be solely responsible for the symptoms reported by the patient. There was stronger evidence that the neuropathy was a result of nerve compression more proximally.

The optimal test item cluster (TIC) proposed by Wainner et al[21] for the diagnosis of cervical radiculopathy consists of 4 clinical tests that were shown to provide significant diagnostic accuracy of cervical radiculopathy.[21] They include the Spurling test-Part A, neck distraction test, median nerve ULTTA, and cervical rotation range of motion less than 60° to the affected side.

The patient demonstrated positive results given the criteria for this TIC on cervical ROM, ULTTA, and neck distraction test. Wainner et al[21] indicate a pretest probability of 23% for the diagnosis of cervical radiculopathy in their sample of patients. With 2 positive tests within the TIC, the post-test probability of CR remains unchanged. Three positive tests increase the positive LR to 6.1 and the post-test probability to 65%. Four positive tests will cause an increase in post-test probability

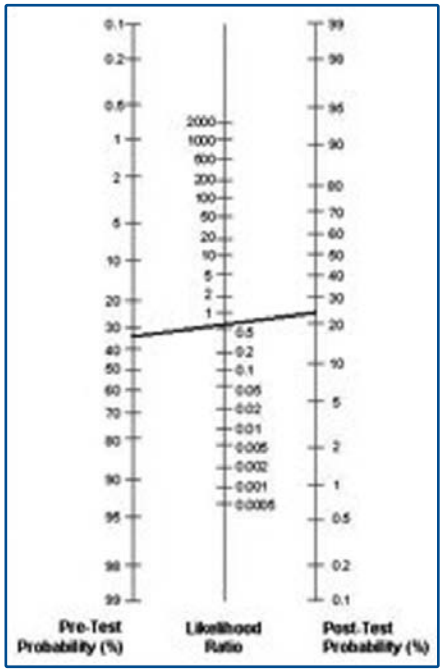

Figure 2. Nomogram depicting the post-test probablility estimate for the diagnosis of Carpal Tunnel Syndrome.

to 90%. Our patient's symptom distribution, documented disc pathology, reproduction of symptoms with extension and positive test results on 3 of 4 examinations the TIC supported a diagnosis of cervical radiculopathy. The post-test probability of cervical radiculopathy could be estimated at 65% according to the CPR **(Figure 3).**

DIAGNOSIS

A diagnosis of CR was supported in this case based on the largest change in post-test probability. The distribution of symptoms in the C6 dermatome was

consistent with an impingement at the level of C5-C6. Neurologic deficits related to CR correspond with the involved disc level in approximately 80% of patients.[45] Carpal Tunnel Syndrome could not be completely ruled out (23% probability) and may be contributing to the current symptoms as a secondary problem. The presence of TOS is unlikely (7.5% probability).

According to the *Guide to Physical Therapist Practice,*[1] the patient's problem could be classified under Practice Pattern 5F (Impaired peripheral nerve integrity and muscle performance associated with peripheral nerve injury) or 4F (Impaired joint mobility, motor function, muscle performance, range of motion, and reflex integrity associated with spinal disorders). Response to treatment was used to support the diagnosis and will be explained in the Discussion.

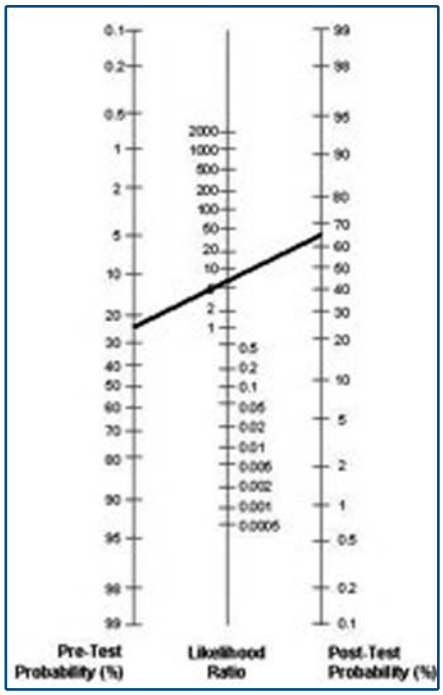

Figure 3. Nomogram depicting the post-test probability for the diagnosis of Cervical Radiculopathy.

DISCUSSION

Intervention

Treatment consisted of individual stretching of the scalenes, sternocleidomastoids, posterior cervical paraspinals, suboccipitals, rhomboids, upper and middle trapezius, and deep neck flexors. Manual cervical distraction was also initiated on the first visit. A progressive resistance program was initiated on the second visit that consisted of exercises to target the cervical extensors and scapular stabilizers, including upper, middle, and lower trapezius; rhomboids; latissimus dorsi; and serratus anterior. Cervical extension was performed on the cervical extension machine by MedX (MedX Corporation, Altamonte Springs, Fla). This machine allows for dynamic variable resistance strengthening of the cervical extensors through a fixed range of motion. Treatment parameters, including sets, repetitions, resistance, and progression are included in **Table 2.**

Outcomes

A visual analog scale (VAS) was used to monitor changes in subjective levels of pain in the upper extremity. The VAS for pain is rated on an 11-point Likert scale from 0 (no pain) to 10 (worst imaginable pain). Pain ratings were measured as the worst pain within the past 24 hours. Upon initial evaluation, VAS pain measure was 6/10. Visual analog scale has been reported to have a test-retest reliability of 0.97.[46] The SF-12 was used as an outcome measure to determine changes in general health status during treatment. The SF-12 has been shown to be a valid and reliable general health outcome measure.[47,48] Changes in the SF-12 are considered clinically significant if greater than 7 points.[49] The Disability of Arm, Shoulder, and Hand (DASH) was used as a region-specific outcome measure to determine changes in functional limitations and disabilities during treatment. The DASH has shown an ICC of 0.92, with strong concurrent validity (r = 0.74) and correlation with the SF-12 physical health scores.[50] The SEM has been reported as 5.66, with a minimally clinically important difference (MCID) of 10.[50] Outcome measure scores, including VAS pain scores, are listed in **Table 3.**

The patient was seen for 11 visits over 6 weeks. Cervical ROM measurements increased for flexion, right sidebending, and rotation; however, these improvements were marginal **Table 1.** More importantly, the patient reported no pain through any AROM movements. He demonstrated significant decreases in subjective reports of pain on a VAS, from 6/10 at initial evaluation, to 1/10 at discharge. The DASH outcome measure did not demonstrate a statistically significant change with therapy. A significant improvement of 7.26 was measured from baseline to discharge with the SF-12.[47] While no significant clinically important differences were noted for specific orthopaedic measures of functional limitation or disability according to DASH scores, the patient did report increased sleeping tolerance to a full 6 to 8 hours without exacerbation of symptoms. He also noted an increased awareness of upright posture while driving and performing desk work. The Spurling test- Part A and B and distraction test were both negative upon discharge; however, the median nerve ULTTA remained positive. The patient was instructed in an independent home exercise program (HEP) consisting of scapular and cervical strengthening and stretching exercises. Due to the decreasing pain symptoms, patient knowledge of self-management of pain, independence with HEP, and access to gym, the patient was discharged.

CLINICAL IMPLICATIONS

Upper extremity neurological symptoms are caused by a variety of pathological conditions acting in concert or individually. Patients displaying such symptoms should be interviewed and thoroughly examined in order to rule out or rule in a potential diagnosis. This case report demonstrated the use of selected measures in the establishment of a clinical diagnosis. Specific emphasis was placed on decision-making using changes in probability. Post-test probabilities calculated from likelihood ratios following a battery of clinical tests were useful in determining a diagnosis.

Due to the drastically different treatment approach for each potential diagnosis, we believe that a clinical diagnosis of cervical radiculopathy was supported by observed improvements in VAS and SF-12 outcome measurement scales after intervention for CR was performed. Sleeping tolerance was measured with patient report and showed improvement throughout the duration of treatment. Region specific measurements of functional limitations as determined by the DASH did not show a significant improvement over the course of treatment. A possible explanation for this nonsignificant change may be related to the choice of the DASH measure as our outcome. Given the low initial levels of functional limitations and disabilities reported on the DASH, we suspect that the

minimal change represented a ceiling effect of the measure. In patients with minimal limitations from cervical radiculopathy, the DASH may not be sensitive enough to measure clinically significant change in upper-extremity function.

Minimal change in ROM was measured over the course of treatment despite decreased pain and symptom intensity. The authors feel this discrepancy may be due to the etiology of symptoms. It is proposed that the neurological upper extremity symptoms were related to nerve irritation or inflammation versus chronic impingement due to physical obstruction. The symmetry of cervical rotation motion bilaterally and relatively low initial levels of ROM impairment suggest that ROM impairments may not have significantly contributed to symptoms. The authors suggest that decreased nerve irritation due to distraction and therapeutic exercise intervention contributed to improved symptoms. Despite the inability of the case study design to establish a cause and effect relationship, we consider the treatment response to be supportive of our diagnostic decision.

A weakness of the study includes the level of validation for the CR CPR. The prediction rule has been derived from a small, retrospective sample. Hence, the level of validation is low. In the hierarchy of evidence for clinical prediction rules proposed by McGinn,[28] this CPR ranks as a level IV. For this level of validation, the clinician is cautioned against applying the rule to a patient that is dissimilar to the patient population for which the CPR is proposed. Our patient was sufficiently similar to the population in the Wainner study to support the application of the CPR. Future research should focus on the validation of this CPR in larger samples. Another weakness of the clinical prediction rule is that such tools are not designed to assess severity of the condition. Reliability and operational definitions regarding the clinical tests must be considered and are not reflected in the diagnostic accuracy provided by the post-test probabilities and, thus, may affect results. The case study could have been strengthened if tests which have been shown to provide good diagnostic capabilities for CTS as part of a test-item cluster, were included in the exam.[29]

Our patient complained of increased symptoms with cervical extension, yet results of the Spurling –Part A test were

Table 2. Exercise Flow Sheet for Interventions Targeted at the Cervical Spine

Exercise	Week 1	Week 2	Week 3	Week 4	Week 5
Upper Body Ergometer	Level 4.0 10 Minutes	Level 4.0 10 Minutes	Level 4.0 10 Minutes	Level 4.0 10 Minutes	Level 4.0 10 Minutes
Cervical Stretches	3x30 second hold, each stretch	3x30 second hold, each stretch	3x30 second hold, each stretch	3x30 second hold, each stretch	3x30 second hold, each stretch
Manual Cervical Distraction	10x30 seconds, 15 second rest	10x30 seconds, 15 second rest	10x30 seconds, 15 second rest	10x30 seconds, 15 second rest	10x30 seconds, 15 second rest
AROM	x 10 each, rotation, flex/extend, cervical retraction	x 10 each, rotation, flex/extend, cervical retraction	x 10 each, rotation, flex/extend, cervical retraction	x 10 each, rotation, flex/extend, cervical retraction	x 10 each, rotation, flex/extend, cervical retraction
Cervical Extension (MED-X)	99 lbs. 20 Repetitions	117 lbs. 20 Repetitions	135 lbs. 20 Repetitions	153 lbs. 20 Repetitions	171 lbs. 20 Repetitions
Shrugs	2 lbs, 2 x 15	3 lbs, 2 x 15	4 lbs, 2 x 15	5 lbs, 2 x 15	6 lbs, 2 x 15
Scapular Retraction	2 lbs, 2 x 15	3 lbs, 2 x 15	4 lbs, 2 x 15	5 lbs, 2 x 15	6 lbs, 2 x 15
Seated Scapular Depression	50 lbs, 2 x 15	60 lbs, 2 x 15	80 lbs, 2 x 15	100 lbs, 2 x 15	110 lbs, 2 x 15
Row	N/A	50 lbs, 2 x 15	60 lbs, 2 x 15	70 lbs, 2 x 15	80 lbs, 2 x 15
Lat. Pull-down	N/A	50 lbs, 2 x 15	60 lbs, 2 x 15	70 lbs, 2 x 15	80 lbs, 2 x 15

Table 3. Results for General and Region Specific Outcome Measures

Measures	Initial Evaluation	3 Weeks	6 Weeks (discharge)
Visual Analog Scale (VAS) - Pain	6	4*	1*
Short-Form -12 (SF-12)	48.24	51.7	55.5*
DASH	7.5	4.2	10.8

*Indicates clinically important change from score at initial evaluation

negative. This apparent contradiction in exam findings may be a result of the operational definition for the 2 Spurling tests. Spurling test-Part B included cervical extension, whereas Part A included only cervical sidebending. Clinically, the positive Spurling Part B findings may have been significant, however, only Part A was included in the TIC. We suspect that this patient's symptoms were not severe enough to give a positive result on the Spurling-Part A. Despite these limitations, we remain confident that this case provides an example of a clinical diagnosis made by determining the change in probability that a certain condition is present following a battery of condition-specific special tests.

Post-test probabilities following individual clinical tests or test item clusters are beneficial decision-making tools to determine diagnosis or direct treatment. Large changes in probability between pre- and post-test enable clinicians to make more definitive decisions. The benefits of a CPR in which the patient satisfies all of the criteria to be diagnosed with the highest degree of certainty are well understood. However, the utility of this or other CPRs to direct clinical decisions with suboptimal positive CPR findings is unknown. Wainner et al[21] propose that 3 or more positive tests provide enough statistical significance to direct clinical decision-making. In this case, 3 out of 4 positive tests result in a positive LR of 6.1 with a 95% CI of 2.0-18.6. This corresponds to a moderate change in probability, according to Jaeschke et al.[32] A positive likelihood ratio greater than 2 indicates a change in probability of at least 15%, which is commonly accepted as clinically significant. Additionally, post-test probabilities greater than or equal to 80% are considered to be the most clinically significant. Therefore, although 65% is greater than 23%, the overall change in probability to support CR is not overwhelming. Despite this limitation, this case demonstrates the usefulness of a CPR to help direct treatment even with only a moderate post-test probability. Furthermore, this case illustrates the utility and application of a CPR to successfully guide treatment when a suboptimal number of positive predictors exist. Unfortunately, no universally accepted "gold standard" diagnostic tests were accessible in order to corroborate this diagnosis. However, the intention of this case report is to demonstrate the procedure by which a diagnosis may be determined in the evidence-based format and an intervention performed in the absence of such tests.

Our intention is not to suggest that traditional wisdom and prior experience have less merit in the development of a clinical diagnosis. Pattern recognition may be effectively used at the start of the hypothetico-deductive process to develop a differential diagnosis. Additionally, the clinician is cautioned against the constrained thinking which often accompanies the sole use of statistics-based decision-making. More recent models of clinical evaluation recognize the contribution of psychosocial variables to a patient's disposition, diagnosis, and prognosis. Evidence-based clinical decision making has been promoted in an attempt to minimize judgment bias among clinicians, and improve efficiency and cost-effectiveness. This is due, in part, to rapidly increasing health care costs, declining insurance reimbursement rates, and the intention to shift to direct access. For example, expeditious and accurate diagnostic practices have the potential to decrease expensive and sometimes unnecessary imaging studies. Additionally, a misdiagnosis may prolong consumption of health care services, thus increasing the financial burden on the patient or third-party payer.

This study highlights the often complicated patient presentation in which signs and symptoms might point to multiple diagnoses and clinical tests may be only moderately conclusive. Clinical tests rarely provide 100% diagnostic accuracy; therefore, it is often difficult to definitively rule conditions in or out. This emphasizes the importance of weighing change in probability following clinical tests, rather than the test results themselves. Embedded within this approach is the utilization of evidence-based decision making. The rehabilitation literature and clinical tools are becoming more readily available to facilitate this process. However, many barriers to the widespread implementation of evidence-based practice still exist in the medical and rehabilitation settings. The approach to diagnosis used in this resident's case problem demonstrates the process by which evidence-based clinical reasoning strategies may be implemented to provide expeditious and cost-effective treatment that is supportive of direct access health care in the field of physical therapy.

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Injuries in the Pediatric Athlete: Etiology and Strategies for Prevention

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ABSTRACT

Background and Purpose: The prevalence of sports injuries in young athletes has risen along with the increase in the number of children participating in organized sports. It is imperative to raise awareness of this problem and its causes among the medical, athletic, and general populations.

Clinical Relevance: Once the causes are understood, it is necessary to start designing and implementing injury prevention programs to help minimize these injuries. Such programs will need to be multifaceted to address the factors contributing to the high injury rate in this population.

Key Words: pediatrics, adolescents, sports injuries

INTRODUCTION

There has been an increase in the number of children participating in organized sports.[1] In 1930, there were practically no organized sports for children.[2,3] Over the past 70 years, the number of children participating in organized sports has risen to about 50% of today's pediatric population.[2,3] In the past 10 years alone, there has been a 21% increase in participation[4] resulting in an estimated 7 million adolescents between the ages of 14 and 18 participating in high school athletics.[5]

As a result of increases in participation, there has also been an increase in the prevalence of sports injuries in the pediatric population.[1,6-8] This increase in the number of injuries among young athletes is due to intrinsic and extrinsic factors.[9] Extrinsic factors are variables that influence the athlete from external sources, whereas intrinsic factors are variables that influence the athlete from within. Hawkins and Methany,[10] estimated that 18 million children would sustain and be treated for a sports/physical activity related injury in the year 2000. Thirty-eight percent of high school children, and 34% of middle school children would be treated by a physician or nurse for a physical activity related injury.[2,11] This number was actually a conservative estimate as many injuries go unreported.[10] Fifty percent of these injuries were projected to be related to overuse.[12] Approximately $1.8 billion would be spent treating these potentially preventable injuries.[10] The overall cost for treating sports injuries in this population is about $33 billion a year.[13]

In addition, approximately 65% of all sports related injuries treated in the emergency room were sustained by individuals younger than 19 years of age.[14] According to the Injury Cost Model of the U.S. Consumers Product Safety Commission in 2003, "injuries in the top 5 female and male high school sports cost an estimated $588 million in direct expenses and $6.6 billion in indirect expenses."[4] Some injuries sustained during childhood continue to have deleterious affects in adulthood.[15,16] The long-term health risks and the cost of treatment associated with these injuries warrant the development and use of prevention strategies.[1,10]

The purpose of this paper is to increase awareness of the prevalence and causes of the increased rate of injury in the pediatric and adolescent athletic population. It will also propose general guidelines and goals for prevention programs. For the remainder of this paper, the term pediatrics will refer to all youths up to, and including, the age of 18.

SOCIAL SEQUELAE

The parties potentially affected by the high incidence of pediatric injuries include the athletes, parents, coaches, teams/leagues, schools, and insurance companies. Although there is no research to support this, the authors hypothesize that surveys of the athletes, parents, coaches, teachers, and pediatricians would undoubtedly reveal areas in which the lives of the athletes are affected. Among them might be: missed practices and games, decreased interaction with peers, living with pain and functional limitations affecting activities of daily living (ADLs), psychological/emotional stresses, lost days of school, and financial expenses to parents. These results could possibly be verified by looking at school attendance records, practice and game participation, documentation of visits to school nurses and doctors, as well as insurance claims indicating money spent and most common injuries.

A number of organizations have been addressing this issue. On federal and state levels, the Consumer Products Safety Commission (CPSC) and the Center for Disease Control and Prevention (CDC) have recently begun to hold national forums on the problem of youth sports injuries.[17] Additionally, the American Academy of Pediatrics (AAP), the American Medical Association (AMA), the American College of Sports Medicine (ACSM), and the American Association of Orthopedic Sports Medicine (AAOSM) are a)mong the many national and sports organizations that have come out with papers addressing many topics including: sport-specific injuries, training, conditioning, nutritional supplements, and safety equipment.[17]

The National Youth Sports Safety Foundation, Inc. (NYSSF) was created in 1989 to disseminate the information collected by as many as 18 national medical and sports organizations.[17] The NYSSF is leading the country in advocating safer sports and injury prevention for youths.[17] Publications of the NYSSF include fact sheets, resource sheets, guidelines, reports,

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a quarterly newsletter, and the Yearbook of Youth Sports Safety (a compilation of information from national and medical sports organizations).[17] The beginning of increased public awareness of this problem is evidenced by the recent publication of an article on this topic by Bill Pennington in the New York Times on February 22, 2005.[18]

FACTORS

Due to their age and lack of physical maturity, there are some conditions that are specific to the pediatric and adolescent population. Injuries that are more commonly seen include:

- Osgood Schlatter's Disease[6]
- Spondylolysis [6,18,19]
- Stress fractures[6,18]
- Little League elbow[19]
- And other growth plate disorders 18 (ie, anterior inferior iliac spine avulsion fracture)

In addition to the above, it is the authors' experience that these athletes also suffer from injuries common to athletes in all age ranges. Sprains, strains, fractures, contusions, and heat exhaustion/stroke are among those conditions that can be prevented. In the effort to prevent these injuries, all modifiable factors should be addressed.

Factors that affect the increase in the number of injuries among young athletes can be categorized as either extrinsic or intrinsic.[9]

EXTRINSIC FACTORS:

1. A rise in the number of children participating each year in organized sports[2,3,7,8,20,21]
2. An increase in the intensity of practices and competition schedules[6,22,23]
3. Participation in multiple sports without time off between the seasons in which to recover[6]
4. Specialization/overtraining in one sport[17,18]
5. Paucity in preseason training[6]
6. Not enough sport-specific training[6,18]
7. Lack of formal training of the coaches in conditioning and training, growth and development, and injury prevention[17,24]
8. Insufficient preparticipation physical exam[17]
9. Hazardous playing field[17,25]
10. Deficiency of properly fitted and adequate safety equipment[17,25]
11. Incorrect technique[17]
12. Poor nutrition[17]
13. Inadequate supervision[17]
14. Contact sports[25]

INTRINSIC FACTORS:

1. Physical immaturity[13]
2. Undeveloped physical skills[26]
3. As children progress through adolescence, there is a difference in the growth rate between bone and soft tissues[10,17]
4. Overuse injuries[6]
5. Overall decrease in the general fitness level of children[17]
6. Biomechanical factors[10,17,25,27]
7. Psychological factors[6,17,25]
   "win at all cost" mentality[22,28]
   "winning is everything or… the only thing"[29,30]
8. Weather[25]

COMPOUNDING VARIABLES

Beliefs, Attitudes, and Values

Beliefs, attitudes, and values are often difficult to quantify, but careful analysis is an essential prerequisite to the planning of a prevention program. This will help improve the impact of the program on the community.

Resistance to change is a common characteristic of human nature and is a cause of the lack of interest in injury prevention programs.[17] It is the opinion of the authors that programs should emphasize the ease of implementing preventative measures without changing the sport itself, easing the anxiety of those that are resistant to change. Some modifications may include: limiting the number and type of pitches thrown by age, limiting the number of teams a child plays on in any one sport, and improving on protective equipment, among others.

A common misconception is that pediatric injuries are not preventable due to the randomness of their occurrence.[17] This opinion has not been supported in the literature, when evaluating the effectiveness of injury prevention programs for ankle sprains and anterior cruciate ligament (ACL) tears.[31,32] Just as systemic diseases frequently have direct causes, pediatric sports injuries also have direct causes, which can often be prevented or controlled.[17]

LACK OF EDUCATION

There is a lack of education on many societal levels due to the prevailing thought among coaches and program administrators that there is no need for educational programs because injuries are not a problem.[17]

Despite the increased prevalence of this problem "there continues to be an over-aggressive culture of organized youth sports."[18] Though health professionals are diagnosing and treating a growing number of these injuries,[33] there remains a paucity in education and prevention. The delay of proper diagnosis, intervention, and prevention can be partially attributed to a lack of integration of formal sports medicine education in the training of pediatricians.[22,33-35]

PHYSICAL/PSYCHOLOGICAL CONSIDERATIONS

The authors have found in their clinical experience that many believe that the bodies of young people are able to withstand infinite stress, and don't realize the damage they are doing when they push the athletes to their physical limit and beyond. In addition, the athletes themselves, like most young people, feel they are indestructible and immortal. This clinical experience is borne out in the literature when it discusses that repetitive microtrauma without sufficient rest can lead to overuse injuries which can effect muscles, tendons, and bones.[6] Unfortunately, this occurs too frequently, for example in the elbow where young pitchers can develop osteochondritis dessicans of the capitellum secondary to excessive, repetitive throwing.[22] Future programs should strive to correct these misguided beliefs that are blinding the sports community.

The importance of attending coaching certification programs developed in order

to establish standards for conditioning and training in the pediatric population must be addressed.[17] Techniques and skills needed in youth sports, the risks specific to pediatric sports, the psychology of the young athlete, the physiology of the developing athlete, and the effect of physical activity on the developing body should be reviewed.[17] Coaches should be encouraged to motivate their athletes to participate in year round conditioning programs, and sport-specific exercise programs targeting aerobic fitness, flexibility, and strength training about 8 weeks before the season.[36]

Parents need to be educated on the benefits and risks of participation in organized sports.[17] The significance of being cognizant of the fact that each child has his/her own level of healthy physical activity and should not be pushed beyond that level must be emphasized.[22] Children not specializing in one sport at too young an age (before 12 y.o.)[17,22,37] is another important factor to be highlighted. Parents also need to be counseled on the importance of allowing the children to control the intensity of sports.[17] If left to themselves, children tend to stay within safe ranges.[17] In concurrence with that, the "win at all costs" mentality[22,29,30] must be de-emphasized.

The athletes themselves need to be encouraged to participate in multiple sports as opposed to specializing in one sport at too early an age.[17,38] Proper stretching and warm-up routines,[13,20] nutrition, hydration,[39] and critically evaluating the use of nutritional supplements[38,40] must also be reviewed with the athletes. The athletes must be deterred from focusing on the importance of winning[22,29,30] to focusing on participation for enjoyment.

The influence of ergogenic aids and nutritional supplements among professional athletes coupled with the "win at all costs" mentality has brought about the increased use of these materials in the pediatric population without thought to the consequences.[22,28,38] This dangerously misplaced value must be combated with educational programs.

All of these improper views can be corrected by demonstrating to all affected parties how they will benefit from injury prevention measures in this population.

PROGRAM GUIDELINES

To date, there is no standard for preparticipation screening.[33] Recently, a preparticipation examination for physical therapists was published in an effort to identify risk factors and strategies for the enhancement of development and performance of athletes.[42] The authors believe that an all-encompassing format needs to be standardized to assess all major systems for potential problems. Members of the preseason screening team will each complete their respective section, allowing for a more thorough assessment of each athlete.

Guidelines for safe return to sports,[17] discouraging the use of nutritional supplements,[40] and proper nutrition and hydration needs to be addressed.[39] Appropriate modification of the rules of adult games, fitting of uniforms and equipment, and playing surfaces should be stressed.[17]

Proper training of the athletes based on the specific sport is important to improve their mechanics and cut down on poor techniques that may lead to injury.[17] At the same time, attention should be paid to the scheduling intensity of practices and competitions, so as not to push the athletes past their physical limitations.[6,17,18] The authors feel that while it is important to prevent sport specialization at too early an age, a fine line needs to be walked to achieve the appropriate balance of participation in multiple sports without participating in too many sports. The athletes that participate in multiple sports allowing them no off season are pushing their physical limitations, which may set them up for overuse injuries.[17]

One way to limit physical stresses experienced by athletes is to modify the environment, equipment, and even the rules of the game in deference to their level of maturity.[17] Adjusting the size of fields, and limiting the number and types of pitches thrown are two examples of possible modifications that can be made.[6,17] These changes can be made without changing the inherent essence of the sport.

In addition to the physical stresses the athletes must endure, psychological pressures to succeed in all their sports can be too much.[17,22] These psychological stresses come from within, and from coaches, parents, and peers.[17,22] These components can start the athlete in a cycle of psychological as well as physical aspects affecting each other, with the potential result being physical or psychological breakdown.

OBJECTIVES AND GOALS OF THE PROGRAM

The authors propose the following objectives and goals for prevention programs based on the information and research presented.

1. Raise awareness of the prevalence of the problem among athletes, parents, coaches, and pediatricians
2. Develop and implement a standardized preparticipation screening program
3. Increase focus on encouragement of higher general fitness levels
4. Improve parental awareness of the individuality of each athlete and the intensity appropriate for each
5. Discourage sport specialization at an early age by encouraging participation in at least one other type of sport
6. Improve knowledge regarding proper nutrition, hydration, and preparticipatory screening
7. Implement a safe and evidence-based preseason training program based on sound training principles
8. Require stretching/proper warm-up before practice/games
9. Increase awareness of appropriate progression of training
10. Require all coaches involved in organized sports to be certified in CPR and First Aid within one year
11. Require that all coaches will have completed a coaching certification program within 5 years
12. Within 10 years, accomplish a 25% decrease in pediatric sports injuries

CONCLUSION

As stated earlier, missed practices and games, decreased interaction with peers, living with pain and functional limitations affecting ADLs, psychological/emotional stresses, lost days of school, and financial expenses to parents are all possible outcomes of this high rate of injury in the pediatric and athletic population. The implementation of injury prevention programs can minimize these negative sequelae. These programs can help optimize the performance of young athletes while limiting the risks to their health.

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Chronic Subclinical Systemic Inflammation as Measured by C-reactive Protein and its Relationship to Physical Therapy

Stacy McCooey, MSPT, DPT
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ABSTRACT

C-reactive protein (CRP) is associated with a number of conditions such as arteriosclerosis, breast and colon cancer, Alzheimer's, type II diabetes, obesity, hypertension, sleep apnea, and macular degeneration. More applicable to the physical therapy profession, however, is the association of elevated CRP levels with overuse disorders, acute low back pain, and osteoarthritis. There is little literature in the physical therapy field addressing the significance of CRP, and many people are unaware and uneducated regarding CRP. Physical therapists are in an optimal professional position to help patients improve their CRP with a holistic approach including aerobic exercise and nutritional changes.

Key Words: *C-reactive protein, inflammation, obesity, interleukin-6, osteoarthritis*

INTRODUCTION

Physical therapists are educated in diagnosing musculoskeletal disorders, prescribing therapeutic exercises, using manual therapy to increase mobility and strength, and improving physical function and quality of life. Often, particularly with the transition to a doctoral education, they are educated in holistic therapy, alternative medicine, and nutrition. With clinical specialties segmenting in modern health care, it is growing evident that reform must occur. That paradigm shift calls for more preventive health care with a holistic approach. The fee for service model often is the limitation to this 'perfect vision,' but physical therapists have the opportunity to educate patients about their current health and future wellness. They may also take that education one step further to prescribe a daily exercise regimen, advise nutritional improvement and recommend healthy lifestyle choices. The physical therapist has the opportunity to see the patient multiple times over the course of weeks or months, allowing a trusting professional relationship to occur, and increasing the chances of encouraging permanent lifestyle changes.

This article concerns chronic inflammation, as measured by high senstivity C-reactive protein (CRP). It will review pertinent research in oder to educate health care professionals on CRP's important consideration in overall wellness, comparable to cholesterol and blood pressure levels.

BACKGROUND

High sensitivity C-reactive protein, or hsCRP, or simply CRP is a plasma protein produced by the liver under the influence of various cytokines.[1,2] Cytokines are a group of proteins and peptides that are used in organisms as signaling compounds, similar to hormones and neurotransmitters, allowing one cell to communicate with another.[3] C-reactive protein is a pentameric protein of the lectin family.[2,3] This globulin appears in serum following certain acute inflammatory conditions, such as rheumatic fever, bacterial infections, and neoplastic diseases.[4] It is now used as a biomarker for subclinical inflammation, and has been linked to many conditions such as heart disease, stroke, hypertension, prehypertension, type II diabetes,[5] metabolic syndrome,[6] colon cancer,[7] depression, peripheral artery disease, and cognitive function.[8] High CRP can be found in individuals who smoke, have high blood pressure, are overweight, and are sedentary.[6] In osteoarthritis CRP production reflects the release in the affected joints of proinflammatory cytokines, such as interleukins 1 and 6 and tumor necrosis factor α, which play a part in the mechanism of cartilage destruction.[2]

NORMAL RANGES

Typically a CRP value of 10mg/L or more is considered indicative of clinically significant inflammation.[9] Recently, the US Centers for Disease Control and prevention and the American Heart Association have stated that people with CRP values in the upper tertile of the adult population (>3.0mg/L) have a risk of cardiovascular disease that is double that of people whose CRP concentrations are less than 1.0mg/L.[10]

Gender

Sturmer reported that in a study of 770 patients, the female sex is independently associated with higher mean serum hsCRP levels (25.9% higher mean).[11] Spector et al observed increased CRP values in women with radiographically defined knee osteoarthritis in a population based, cross sectional study of 845 women, as well as higher CRP values in women with radiographic OA progression during a four year follow up.[12] Lakoski et al found that in a study of 6814 men and women, females had higher median CRP levels (2.56 s 1.43mg/L P<.0001), and gender differences remained after accounting for BMI and other potential confounding variables. [13] Further research is needed to find optimal gender-specific CRP cutoffs.[13]

Ethnicity

Of 15 studies, 14 found differences between racial/ethnic groups such that whites had the lowest levels, while blacks, Hispanics, and South Asians had higher CRP levels.[14] The author of this review stated that "most analyses in the literature are underestimating the true effects of racial/ethnic and socioeconomic factors due to adjustment for mediating factors." [14] However, these mediating factors are important in determining true causes for increased CRP levels.

Socioeconomic Position

Whether a cause or result, we must consider the associate of CRP with socioeconomic position. The review by Nazmi and Victoria, 19 of 20 articles found an inverse association with socioeconomic position (SEP) and C-reactive protein. [14] Additionally, in a study of 12,681 white and

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African-Americans it was found that low individual- and neighborhood-level SEP in childhood and adulthood are associated with modest increments in adult inflammatory burden.[15]

DIAGNOSTIC USE AND TESTING

Measuring and charting C-reactive protein values can determine disease progress and the effectiveness of treatments.[7] Patients may receive a simple venous blood test through their doctor to obtain their concentration of CRP. The absolute value can indicate systemic inflammation, and can also be used as a comparison once measures are taken to improve their CRP. These blood tests are being used to predict the efficacy of lumbar epidural steroid injections,[16] the severity of rheumatoid arthritis,[17] and cardiovascular disease.[18] Analytical methods such as ELISA, immunotubidimetry, rapid immunodiffusion, and visual agglutination are used to find CRP levels, measured in milligrams per liter.[7] High sensitivity CRP has been shown not to vary during the day in healthy people[19] and to have variability and classification accuracy similar to that of cholesterol screening.[20] It is the authors' suggestion that, like cholesterol and blood pressure today, inflammation be measured and be known to the patient. With proper education this may give the patient further knowledge of his/her health and risk of disease.

History

C-reactive protein was originally discovered by Tillet and Francis in 1930 as a substance in the serum of patients with acute inflammation that reacted with the C polysaccharide of pneumococcus.[7] In 2003 the American Heart Association and the U.S. Centers for Disease Control and Prevention (CDC) jointly endorsed the test and released guidelines for its use.[21] It was not until early 2005 that articles began to appear in mainstream magazines and now studies indicate that CRP may be as important —if not more important— in predicting and preventing heart disease as cholesterol levels are.[6]

DISCUSSION

Osteoarthritis

Osteoarthritis (OA) is a common joint disease that physical therapists will inevitably see in their practice, either directly or indirectly. Although osteoarthritis is thought to derive from defective chondrocyte metabolism and thus inherently lack the large scale systemic response of rheumatoid arthritis, there is increasing interest in the acute phase proteins in OA.[11] It is now evident that systemic hsCRP levels reflect synovial inflammation in OA patients, perhaps by means of synovial IL-6 production.[22] Conrozier suggested that CRP production reflects the release in the affected joints of proinflammatory cytokines such as interleukins 1 and 6 and tumour necrosis factor α, which play a part in the mechanism of cartilage destruction.[23] Evidence continues to grow that systemic markers of inflammation are associated with severity or clinical course of OA, as well as the disease progression.[22] There has been little research to determine if lowering CRP decreases the severity of the condition, but many factors *are* directly involved.

C-reactive protein has been shown to be slightly but significantly higher in patients with OA than in matched controls.[12] Furthermore, CRP was found to increase in patients with knee OA showing disease progression[12] and in patients with rapidly destructive hip OA.[23] Longitudinal studies with repeated assessments of hsCRP and pain are needed to assess the possible value of hsCRP for monitoring or predicting the clinical course of OA.[11] It may also be important in preventing the progression of the condition, or assessing if patients are at high risk for developing generalized OA.

Often physical therapists will see patients with arthritis in the knee, but also complain of stiff, achy joints in the hands, neck, or low back. Sturmer looked at 809 joint replacement patients with OA, and patients reporting pain in a joint region in addition to the osteoarthritic operated joint also had higher CRP levels.[11] This is important because increased pain in a joint could predict functional impairments, increased need for physical therapy, and future joint replacement. The research on radiographic evidence of OA and CRP levels is conflicting. According to Conrozier, CRP does not correlate with radiographic joint space width in hip osteoarthritis.[2] But Creamer states that although OA pain and radiographic findings correlate to some extent, many patients with advanced radiographic OA have no pain and a fair proportion of patients with pain show no radiographic signs of OA.[24] "Therefore, mechanical factors alone are insufficient to explain pain in OA.[11] This is significant because in physical therapy, despite the radiographic presentation, the clinical presentation will dictate the patient's level of function and rehabilitation potential. Wolfe observed that disability (as assessed by the Health Assessment Questionnaire), number of tender joints, and pain were associated with higher mean CRP levels in 655 men and women with clinically defined OA of the hip or knee.[25] Physical therapy goals are based on the patient's level of daily function and ability to participate in instrumental/social activities. C-reactive protein may have a role in these goals.

Pain

Severity of pain, but not extent of OA, has been associated with hsCRP levels in advanced OA.[11] Every increase of 10mm on the visual analog scale (VAS) was associated with a 5.7% increase in mean serum hsCRP (95% CI 1.1 to 10.4).[11] A clear association between intensity of pain and hsCRP levels was seen with a monotonic increase in mean serum hsCRP with increasing pain severity.[11] This is important to physical therapists because pain is a significant outcome measurement, and often the main reason patients seek treatment. A separate analysis in this study with intensity of pain categorized as quintiles again showed a monotonic increase in mean hsCRP values for increasing categories of pain. It is clear there is a strong association with CRP, but further research needs to be conducted to determine the cause and effect relationship.

Low Back Pain

Low back pain is one of the most common complaints a physical therapist may treat in his or her career. C-reactive protein has been correlated with acute sciatic pain, but not in those with chronic low back pain.[11] In a study of 72 patients (31 with acute sciatic pain) mean intensity of pain during the previous 24 hours as assessed by VAS was independently associated with high levels of hsCRP.[11] Those with chronic pain did not show any correlation.[11] This prompts the question if CRP the cause or result of the pain, but nevertheless the severity of pain from musculoskeletal disorders might be associated with low grade systemic inflammation.[11] Gebhart et al found that in patients with acute lumbosciatic pain, hsCRP declined significantly in the initial period of 3 weeks with a corresponding decrease in pain and improvement in function and clinical evaluation

(as assessed with the straight leg raise test).[26] In a study of 48 patients with 53 matched controls, Sugimori studied lumbar disc surgery and postoperative recovery. A positive correlation was found between the concentration of hsCRP before operation and the JOA (Japanese Orthopaedic Association) for postoperative recovery score after.[27] They stated the significantly high concentration of serum hsCRP might indicate a systemic inflammatory response to impingement of the nerve root caused by disc herniation and might be a predictor of recovery after operation.[27] It was also found that with lumbar epidural steroid injections (LESI) for disc herniations, the higher the hsCRP levels prior to LESI therapy, the less improvement in pain scores following LESI.[16] The results of this study suggest that elevated hsCRP levels may be useful for objectively evaluating and predicting responses to LESI in those patients with lumbar disc pathology with lower extremity radiculitis.[16]

Overuse Disorders

Musculoskeletal disorders (MSD) from overuse are common occupational health problems that cause pain, functional loss, and loss of work time. In a small study of 22 subjects with upper extremity MSD for no longer than 12 weeks, CRP was strongly correlated with Upper-Body Musculoskeletal Assessment (UMBA).[28] These results are of clinical importance as they suggest that early-onset overuse-related MSDs may have an inflammatory component.[28] Again, further research needs to be done to conclude if low grade systemic inflammation increases the production of overuse disorders, or if there is an inflammatory response to such.

APPLICATIONS

Serum hsCRP has been identified as a useful marker for predicting the efficacy of lumbar epidural steroid injections, and recovery after disc surgery.[28] It is correlated with maximal temporomandibular joint opening in patients with rheumatoid arthritis.[17] Often it is difficult for a physical therapist to predict the course and outcome of treatment and CRP may be a useful piece of the puzzle. Knowledge of C-reactive protein levels may aid in a physical therapist's plan for frequency and duration of therapy, as well as patient education topics. More importantly, as shown from the literature above, it is in the patient's best interest to take steps to lower their level of systemic inflammation.

CALL TO ACTION

With the increased specialization of modern western health care, often the big picture is overlooked. Time constraints or the fee-for-service model may be restrictions for a health care professional to address a patient's health holistically. An orthopedist will look at the patient's knee, an internist at blood sugar levels, and their cardiologist at their EMG. It is important to accept the fact that chronic, subclinical inflammation is the driver of most, if not all, chronic diseases.[29] There has to be an obligation in the medical field to address the patient's health from multiple facets, and help them to understand that many of their disease conditions may be related to their lifestyle.

REDUCING CHRONIC INFLAMMATION

Nutrition

It is the rare physician who includes diet therapy and nutritional supplements in patient care.[29] A Mediterranean-type diet has been shown to lower CRP levels.[30-32] Evidence suggests that fruit, vegetables, omega-3 animal products (eggs, lean meats, fish, poultry, wild game), and raw nuts should be the main components of a healthy diet. Refined sugar grains, soy, beans, and dairy are not recommended as primary sources of energy, and are not comparable to fruits, vegetables, and nuts when it comes to nutritional density and phytonutrient content.[33] The EPA and DHA for omega-3 fatty acids, vitamins A, C, E, zinc, and iron have been suggested in an anti-inflammatory diet. However Nanri states that high intakes of carotenoids and vitamin C, but not of vitamin E, seem to decrease the level of circulating hsCRP.[34] But the author does confirm that high consumption of vegetables and fruit are associated with lower levels of circulating hsCRP, perhaps by exerting anti-inflammatory effects.[24] Consistent with fruits and vegetables, diets high in fiber are associated with lover levels of inflammatory markers.[35] Results in this study of 35 participants showed that fiber intake of about 30g/d from a diet naturally rich in fiber or from a supplement can reduce levels of CRP.[35] It was also found that fiber intake is independently associated with serum CRP concentration and support the recommendation of a diet with a high fiber content.[35] Further individual components of diet have been studied, as opposed to whole foods and dietary patterns. Wells found a relation between arginine intake and CRP level that persisted after controlling for factors associated with CRP.[36] Intake of arginine-rich foods such as nuts and fish demonstrates decreased odds for having high CRP levels.[36]

Possibly the largest and most applicable collective study was done by Nettleton et al using factor analysis of 5089 nondiabetic participants in the Multi-ethnic Study of Atherosclerosis.[37] The fats and processed meats pattern (fats, oils, processed meats, potatoes, salty snacks, desserts) was positively associated with CRP (P for trend < 0.001).[37] In contrast the whole grains and fruit pattern (whole grains, fruit, nuts, green leafy vegetables) was inversely associated with CRP.[37] This grouping gives physical therapists the basic information to recommend nutritional improvements to their patients.

In a randomized, double blind, placebo controlled study of 90 patients with increased levels of CRP, 300mg Neptune krill oil daily reduced CRP levels by 19.3%.[38] This reduced pain scores in their osteoarthritis by 28.9% (p=0.05), reduced stiffness by 20.3% (p=0.001), and reduced functional impairment by 22.8% (p=0.008).[38] Further studies should be done on this unique supplement, as little has been published. This may be significant in demonstrating the effect of nutritional supplements causing a subsequent reduction in CRP simultaneous with improvements in stiffness, pain, and function.

The literature regarding the effects of tea, coffee, and caffeine on CRP is conflicting. In 2004 Zampellas found that compared with non-coffee drinkers, men and women who drank more than 200mL of coffee had 30% and 37% higher CRP, respectively.[39] This was a large study of over 3000 participants. In 2006 Bacquer concluded that tea consumption is significantly associated with CRP,[40] but coffee drinking proved unrelated to chronic inflammation. In a small prospective study Steptoe found chronic tea consumption to reduce platelet activation and plasma C-reactive protein in healthy men.[41] It seems that tea may be beneficial, but further research is deemed necessary before making dietary recommendations to physical therapy patients.

Tobacco

In a study by Sturmer, the most important independent predictor of serum hsCRP levels in patients with OA was smoking, especially current smoking, but former smokers also had significantly increased levels of serum hsCRP.[11] Aside from inflammatory reasons, physical therapists should assist their patients in smoking cessation, as it impedes oxygen delivery to tissues, negatively affecting rehabilitation outcomes.

Exercise

Exercise has the ability to reduce blood pressure, increase bone density and fibrinolytic activity, improve body composition, lipid profile and glucose tolerance, and enhance mood.[1] Now evidence is accumulating that regular physical activity provides an important health benefit as an anti-inflammatory agent.[1] Although it is unclear how physical activity levels influence inflammatory activity, there have been suggestions such as improving insulin resistance, lowering BMI, improving endothelial function, and reducing endothelial cell secretion of IL-1 and IL-6.

Although acute bouts of exercise are well known to increase concentrations of proinflammatory cytokines and acute-phase reactants, chronic (regular, long-term) physical training may reduce basal concentrations of inflammatory markers.[42] Multiple cross-sectional observational studies have shown an inverse association between markers of systemic inflammation and physical activity and fitness status.[42] This does not alter with age, and continues even with adjustments for BMI. Further, there has been research that shows reduction of inflammatory markers in local skeletal muscle with exercise training. This suggests that exercise may elicit local anti-inflammatory effects that may or may not be evident in the systemic circulation.[43]

Several cross-sectional studies have demonstrated an inverse relationship between levels of physical activity and inflammatory markers.[1] Longitudinal studies support this relationship as well. Among 43 asymptomatic middle aged adults with elevated CRP, a 6-month supervised exercise program resulted in a 35% decline in CRP.[44] Adamopolous et al demonstrated that physical training induced a significant reduction in peripheral inflammatory markers compared with the detraining period in patients with chronic heart failure.[45] Further, in a study of 277 people it was found that the magnitude of the CRP decline in exercisers was similar regardless of whether they gained or lost weight.[46] Although it is unclear how physical activity levels influence inflammatory activity, there have been suggestions such as improving insulin resistance, lowering BMI, improving endothelial function, and reducing endothelial cell secretion of IL-1 and IL-6.

The effects of exercise are not always evident systemically in serum, but in the muscle tissue itself. Geilen et al demonstrated increased local expression of tumor necrosis factor α, IL-1, B, and IL-6 in skeletal muscle biopsies from patients with chronic heart failure.[43] After 6 months of home exercise training on a cycle ergometer, local expression of these inflammatory cytokines decreased 36% to 52% in vastus lateralis muscle biopsy specimens, although serum levels were unaffected by training. These local anti-inflammatory effects of exercise may attenuate the catabolic wasting process associated with the progression of CHF.[43]

Regarding what *type* of exercise is *most* beneficial, King et al looked at 4072 participants and found that a significant lower likelihood of elevated inflammatory markers among regular participants in jogging, swimming, cycling, aerobic dancing, calisthenics, and weight lifting; but not for gardening.[47] The authors were unable to exclude the possibility that differences may be due to exercise intensity or duration. A study looking at 64 adults found that aerobic exercise resulted in significant reductions in serum CRP compared to flexibility/strength exercise treatment.[48]

Despite lacking specific exercise type, duration, intensity, and frequency, the literature *does* clearly support the benefits of exercise in general. Physical therapists have the opportunity to, at the very least, educate their patients and encourage them to exercise. At most, therapists may be *the* health care professional to design an exercise prescription and include it in their plan of care.

Body Fat Reduction

Reduction of adipose tissue is often a result of increasing exercise and improving nutrition. However net caloric intake must be negative, either from increased energy expenditure or decreased caloric intake. Comorbidities, hormones, genetics, lifestyle, medications, socioeconomic position, environment/stress, and psychological factors all may affect body fat loss.[49] Adipose tissue is an important determinant of a low level, chronic inflammatory state.[50] Adipose tissue is "inflamed" in obesity, with decreased expression of the anti-inflammatory adipokine adiponectin and increased secretion of a variety of proinflammatory cytokines, eg, tumor necrosis factor α, interleukin (IL)-6, and prothrombic factors such as plasminogen activator inhibitor-1.51 John also found that subcutaneous adipose tissue secretes interleukin-6 in vivo.[50] C-reactive protein is largely mediated by circulating levels of interleukin-6.

Correlations

C-reactive protein is correlated with body mass index (BMI) ($r = 0.4$, $p < 0.0001$), and waist circumference ($r = 0.33$, $p < 0.0001$).[52] A large-scale cross-sectional study of over 16,000 men and women found that higher BMI is associated with higher CRP concentrations.[53] The associations are true for all ages. Strong inverse correlations were found between CRP levels and BMI in 2846 children ages 3 to 17 years.[54] In addition to weight and BMI, chronic inflammation is also correlated with waist circumference, hip circumference, and waist-hip ratio. In obese subjects, CRP is also significantly correlated to visceral adipose tissue determined by computerized tomography scan.[8] The positive associations of obesity and visceral adiposity with elevated cytokine levels suggest the importance of reducing obesity and visceral adiposity to prevent elevations in cytokine levels.[8]

Glucose and Insulin

It has been found that improvement in glucose metabolism with weight loss programs are independently associated with decreased cytokine concentrations, suggesting that a reduction in inflammation is a potential mechanism that mediates improvements in insulin sensitivity.[55] In drug-naïve type II diabetic subjects, markers of inflammation and fibrinolysis are strongly related to the number of metabolic syndrome components.[56] For CRP this relationship is determined by body adiposity and not by insulin sensitivity or glucose control.[56] In this study of 921 subjects there was a strong relationship between the number of metabolic syndrome components

and these inflammatory and fibrinolytic variables.[56] However, the relationship between the number of metabolic syndrome components and CRP appeared to be largely the result of obesity as it was markedly attenuated, becoming nonsignificant after adjusting for BMI.[56] This, in addition to other studies,[57,58] are in keeping with adipose tissue and its cellular components being an important site for the production of this proinflammatory cytokine. Behavioral changes resulting in weight loss have been shown in both diabetic subjects[59,60] and individuals with impaired glucose tolerance to markedly decrease CRP levels.[61]

The mechanisms by which weight loss reduces inflammation is beyond the scope of this text, but include the following:

1. *decrease in adipose-tissue cytokine production*
2. *reduce local production of IL-6 and TNF-α*
3. *down-regulate pro-inflammatory genes*
4. *up-regulate anti-inflammatory genes*

CONCLUSION

This article has discussed C-reactive protein, how it relates to physical therapy, and how medical professionals can holistically help patients improve their health. It is clear that chronic inflammation is related to many disease states. Lifestyle choices can attenuate this. Smoking, sedentary lifestyle, processed food intake, and adiposity all increase CRP levels. Comprehensive research is needed to determine the relative effects of each of these factors. In addition, the immediate correlation between CRP levels and physical therapy measurement such as range of motion, strength, edema, and pain may be beneficial. In the meantime patients can be proactive in their wellness and ask their doctor for a simple, inexpensive blood test to determine their CRP levels. The information here regarding CRPs broadens physical therapists' clinical scope and professional responsibility to include anti-inflammatory recommendations on nutrition, total body wellness, and daily exercise.

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bookreviews

Coordinated by Michael J. Wooden, PT, MS, OCS

Donelson R. *Rapidly Reversible Low Back Pain: An Evidence Based Pathway to Widespread Recoveries and Savings.* Hanover, NH: Self Care First, LLC; 2007, 233 pp.

The author of this text, Ronald Donelson, MD, MS, is a self-proclaimed "recovering surgeon," who now specializes in academic-based, nonoperative spine care. Donelson's goal in this book is to present a common sense and evidence-based approach to low back pain (LBP). The text has a widespread target audience including LBP sufferers and their families; employers and payers who bear some of the economic hardship of the LBP epidemic; clinicians treating LBP (including general practice and specialty physicians, osteopaths, physical therapists, and chiropractors); researchers investigating diagnosis, treatment, and epidemiology of LBP; and professionals in the disease management industry. Due to the weak and nonspecific research-based guidelines, these "stakeholders in LBP" realize increased frustration regarding timely and cost-effective management.

Donelson examines the flaws in much of the current LBP research, which tends to treat the majority of LBP sufferers equally, without differentiation of cause or pathology. Donelson asserts the fact that LBP is, in fact, a symptom, rather than a true diagnosis. Often patients with complaints of low back pain are lumped into 3 categories: (1) "red flag" patients including those with tumors, infection, or fracture; (2) herniated disc patients with neurological effects; and (3) those with nonspecific LBP which encompasses 85% of all diagnoses. Donelson refers to this last category as the "Black Box" of LBP. This is the group that is resulting in lengthy, costly, and often-ineffective treatments provided by a variety of health care professionals. Donelson asserts that the lack of specific diagnoses for these subgroups is due to the inadequacy of most research. In turn, the clinical guidelines set forth based on this research are impractical and insufficient. Clinicians resort to their own highly variable methods based on personal, educational, and clinical experiences, without regard to guidelines established by the research community, often resulting in inconsistent and frustrating outcomes for patients and payers.

Current trends in the research also point to an extremely positive "natural history" of LBP. However much of this evidence is based on statistics regarding patients seeking continued care following an initial onset of acute LBP. Donelson presents evidence that a patient's lack of follow-up is not directly correlated to resolution of pain and impairment related to their LBP, and is an inaccurate measure of natural history. Guidelines routinely assert the highly favorable outcome of 90% resolution within 6 weeks to 3 months of onset. However, frequent and often severe reoccurrence rates are not addressed by these guidelines and often go ignored by clinicians in their communication with patients. Recurrent episodes of LBP cannot be examined as discrete and unrelated incidents, as with a common cold or the flu. Research shows that recurring episodes are often more severe and longer in duration, eventually resulting in chronic LBP. Donelson asserts that accurate diagnosis at initial onset of LBP, with appropriate intervention, education, and secondary prevention are the keys to breaking the LBP cycle.

Donelson goes on to the describe Robin McKenzie's Mechanical Diagnosis and Therapy (MDT) approach. McKenzie first described his methods in 1981. His assessment techniques allow for specific categorization of LBP patients based on positional pain generators, using repeated motion testing to end-range. With this method there is no need to identify the anatomical source of the patient's pain in order for them to achieve full recovery. The MDT methodology divides LBP patients into 3 mechanical subgroups: Derangement Syndrome, Dysfunction Syndrome, and Posture Syndrome. Donelson describes these subgroups and their characteristics, followed by treatment for these groups, based on McKenzie's teaching. He includes evidence-based research designed around these diagnostic groups and specific interventions.

The author asserts that by using these techniques for assessment, clinicians will be better able to assign an accurate diagnosis to their patients, thereby focusing more quickly on appropriate treatment techniques, and breaking the cycle of recurring LBP. He then includes discussion directed at payers and employers focused on cutting costs and decreasing spending for the treatment of LBP suffers.

This text offers the clinician treating LBP objective, clinical methods for diagnosing and treating their patients. In addition, it is a helpful reference for employers, payers, and disease management professionals in their efforts to decrease costs in managing low back pain. However, Donelson is somewhat biased in his presentation of the McKenzie MDT method as the most effective method of assessing, diagnosing, categorizing, and treating LBP patients. He should also consider other mechanically based assessment and treatment systems.

That said, I believe this book is an excellent compilation of evidence-based research as well as a comprehensive common-sense based approach to the management of LBP. It will be an excellent tool for the entry-level therapist or physician in their efforts to treat patients with LBP.

Amanda Blackmon, DPT

Flynn TW, Cleland JA, Whitman JM, eds. *User's Guide to the Musculoskeletal Examination: Fundamentals for the Evidence-Based Clinician.* Buckner, KY: Evidence in Motion; 2008.

Evidence-based medicine is certainly a popular phrase among physical therapists, and especially within DPT curricula, but it is still not common to find comprehensive texts with current references for the entire musculoskeletal exam. As a result, perhaps the physical therapy community does not have uniform awareness of the usefulness of the tools we use in the clinic. This book is such a text, providing a compact, evidence-based guide to the musculoskeletal examination.

The book starts with chapters on functional assessments, medical screening, and neurological screening. The functional assessments are a welcome inclusion, especially since so many payers are now requesting functional outcome scores to determine reimbursement. Several outcome tools are listed along with the reliability of each. An added bonus is that each outcome tool is available in PDF form on the included CD. The medical screening chapter presents excellent lines of questioning for each system along with pictures and diagrams that every clinician should review regularly, especially with the growing population with direct access to physical therapy. The upper and lower quarter screening chapter is a brief but thorough overview with great color examples.

Next, the authors dedicate chapters to assessment of body regions, including the cervical spine, shoulder, elbow, hand/wrist, temporomandibular joint, lumbar spine, hip, knee, and ankle/foot. The authors include taking a history, observation, palpation, range of motion, accessory motions, resisted muscle testing, and special testing. Each procedure includes color pictures and straightforward descriptions.

Comprehensive reference lists are available for each chapter, and the included CD has the entire book in PDF format, in addition to links to the aforementioned outcome tools.

One weakness of this book would be the lack of additional special tests and measures, especially for shoulder pathologies (eg, Speed's, Biceps Tension, Thoracic Outlet tests, etc). These may not have been included due to lack of space, lack of research, or lack of reliability or accuracy. If it was due to lack of reliability or accuracy, it would still be helpful for clinicians, especially new graduates or those with limited awareness of research, to know which tests have been proven weak clinically.

Another minor weakness is that, although the authors include specific reliability measures such as Kappa coefficient and intraclass correlation coefficient (ICC), they do not include definitions of these statistical tools. Definitions would assist those unfamiliar with research to interpret their results.

The strengths of this book lie in the authors' organization and layout. Techniques for all procedures are well explained, the pictures are descriptive, and procedures are separated on different pages to improve ease of use. Overall, this text provides a concise, well-organized reference in a small package that I would recommend to any clinician.

Susan S. Smith, DPT

Law M, MacDermid J, eds. *Evidence-based Rehabilitation: A Guide to Practice*. 2nd ed. **Thorofare, NJ: Slack, Inc.; 2008, 434 pp.**

Law and Mac Dermid have created a text that deals exclusively with evidence-based rehabilitation (EBR). This text is designed specifically for occupational and physical therapists, as well as for students. An instructor's manual is available to assist both faculty and students. At the end of each chapter, there is a section entitled

"Learning and Exploration Activities," in which questions are provided to challenge the student and therapist to develop their knowledge in this topic.

The first 3 chapters serve as an introduction to EBP. Here the EBP is traced back to its origins. Research is presented in detail regarding attitudes and beliefs, as well as classification of practitioners, as it pertains to EBP.

The second section is entitled "Finding the Evidence." Outcome measures are discussed in great detail. Interesting material is presented about Quality of Life outcomes. There are some case studies that are presented that illustrate how outcome measures can be used in the clinical setting. Terms that are found in outcome measures research are defined. These terms are defined, not just by their meaning, but also by what the number tells you, what it represents, how it can interpreted, and cautions about using their use. The following chapter contains information about how to ask a good clinical question using the P.I.C.O approach. The *P* stands for client/population, *I* is for intervention/exposure, *C* is comparison, and *O* is for outcome. Selecting the appropriate information sources is covered. Fine tuning a literature search using the internet is discussed here. Databases such as MEDLINE, PEDro, RehabDATA among others are presented.

The next 4 chapters make up the third section, "Assessing the Evidence." The different levels of strength of evidence are discussed in detail. Systematic reviews are presented as are methods for the reader to assess these reviews by using various sources. A step by step process is described regarding how to find systematic reviews. In the next chapter of this section, different forms of evidence are compared. Examples of these different types of comparisons are illustrated using low back pain, stroke rehabilitation, cervical manipulation, and total knee arthroplasty. The final chapter in this section is dedicated to evaluating the economic effectiveness for the relative value of health services. The 5 different types of economic evaluation are: cost-consequence, cost-minimization, cost-effectiveness, cost-utility, and cost-benefit. Each of these were defined and examples of their use in the rehabilitation literature were cited.

The last section was entitled "Using the Evidence." The first chapter in this section concentrates on strategies to build EBP into your practice. Different approaches are proposed by the authors regarding successfully implementing EBP. In the "Take Home Messages" section, it is stressed that clinicians continue to use clinical reasoning and pay close attention to the patient's goals, needs, and values. The barriers and solutions of using and performing EBP in the clinic are presented in realistic terms. Critically Appraised Topics are introduced. These are a summary of the evidence related to a single topic or a specific clinical question. A chapter is dedicated to practice guidelines, algorithms, and clinical pathways. The process of developing and implementing these methods of providing care are presented clearly and in great detail. A chapter is devoted to communicating evidence to patients, managers/administrators, and insurance funders. It is stressed that communication be effective so that the particular audience understands and makes changes based on the evidence. The chapter "Research Dissemination and Transfer of Knowledge" deal with the difficult task of putting the research into practice.

Various models of knowledge transfer are presented along with specific research transfer strategies. The last chapter is a specific example of this as it relates to disseminating the evidence about children with developmental coordination disorder. This valuable chapter exposes the reader to the process from start to finish. There are 14 appendices that the reader has been referred to throughout the text. These include worksheets that will assist the reader in starting their pursuit of EBP.

This is a very comprehensive text. It is clearly written and well referenced. Throughout this text, step by step processes are described to explain the research of various topics. The somewhat daunting task of starting the research process is made much easier by the authors. Numerous web sites are offered to assist the reader. Each chapter is summarized by a take home messages section. These sections are concisely done. I would recommend this text to any provider or student who is delving into EBP. I would also recommend this text for any university level course on EBP.

Jeff Yaver, PT

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Birmingham, AL . . . . . Naas . . . . . Sep 25 - 28
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San Francisco, CA . . . . Turner . . . . . Oct 16 - 19
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CF 3: Advanced Cranio-Facial
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Crossword by Myles Mellor
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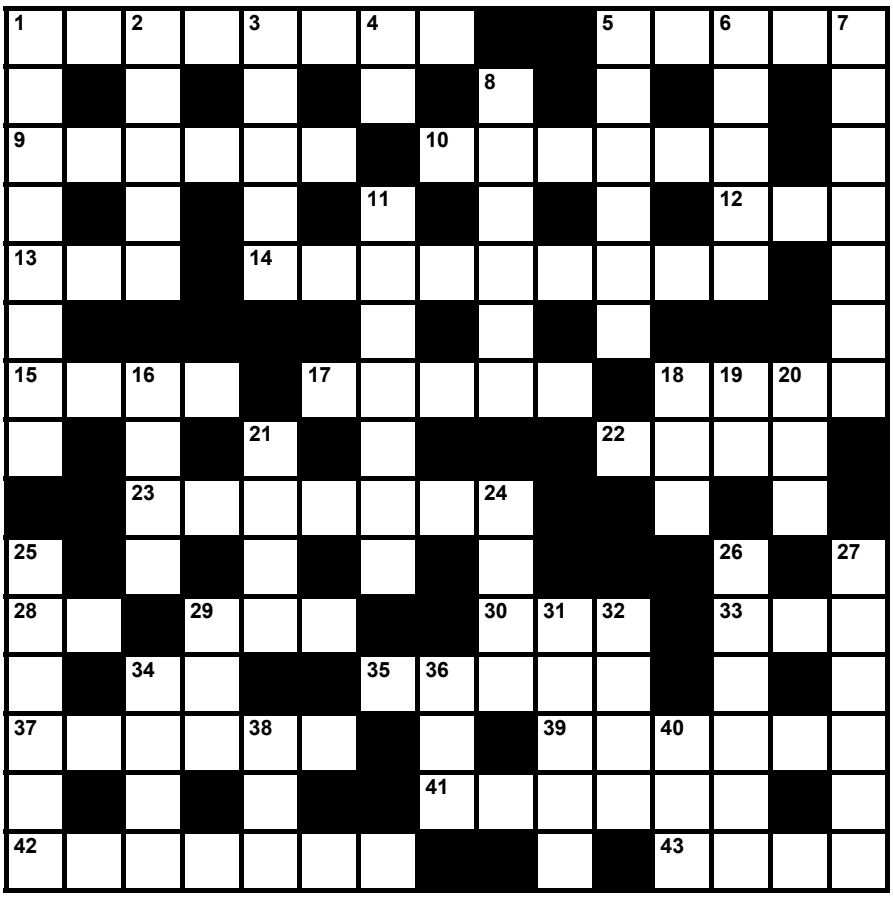

Across

1. Tibialis _____ enables the foot to move upward
5. These can create a lot of problems for the feet
9. Big toe
10. Arch ligament: plantar ____
12. Agreement word
13. Weight measure, for short
14. They sometimes form at the tip of the calcaneous
15. Medical inspection
17. Unmoving
18. Occasional noises made by bone motions
22. Strong and sure
23. Bending a limb
28. Morning time
29. Alcoholic's withdrawal symptom
30. The first is the big toe
33. Third in the family
34. Anti-oxidant, abbr.
35. One of the long bones of the lower leg
37. Flexor is one
39. Put a bone back in place
41. Relating to the back
42. Tear
43. One part of the foot

Down

1. Foot tendon
2. It meets the tibia
3. Calloused
4. Over
5. Spine base
6. Approves
7. Ligament wrenches
8. The midfoot has five irregularly shaped ___bones
11. A foot ligament
16. The most commonly injured ligament in the ankle
18. Fractured bone connector
19. Either's partner
20. Pre-period condition
21. They contain 26 bones
24. Unfeeling
25. What malleolus means
26. One of the long bones of the lower leg
27. Phalanx bone of the big toe
29. Medical man
31. Crown
32. Protective gear for the shins
34. When to see a physical therapist if you are suffering from chronic foot pain
36. Identified, abbr.
38. Louisiana university
40. Injection (slang)

OHSIG PRESIDENT'S MESSAGE 2008

Greeting OHSIG Members!

The OHSIG BOD held a conference call May 15 and welcomed new BOD members Steve Allison, Vice President; Rick Wickstrom, Membership Chair; and John Lowe, Nominating Committee Member. Remaining BOD members include Margot Miller, President; Nicole Matoushek, Treasurer; Joe Kleinkort, Secretary; Dee Daley, Education Chair; Kathy Rockefeller, Research Chair; Drew Bossen, Practice Chair; and Jen Pollack, Nominating Committee Chair. You can find contact information for the BOD on the Ortho website, under Occupational Health SIG.

We are very pleased to announce that the Executive Summary of OHSIG Practice Analysis is complete and included in this issue of *OPTP.* David Miller has taken the lead on getting this to print; the BOD would like to thank him for his time/effort. The BOD would also like to thank Ken Harwood for his time, as well as recognize the authors: David Miller, Kathy Rockefeller, Dee Daley, Jen Pollack, Deborah Lechner, and Margot Miller. This information will be critical for developing curriculum in Occupational Health Physical Therapy.

Next on the BOD's agenda is to finalize the petition document in support of certification in OHPT. Part of the document requirements was publication of the findings from the Practice Analysis, which we have now met.

The final draft of the FCE Guidelines is near completion with plans to disseminate to the FCE Task Force and CSM FCE Working Group for feedback early June. Rick Wickstrom and Gwen Simmons have taken the lead on compiling feedback. We thank them for their involvement in this important project.

Region V OSHA and APTA initiative is underway. The efforts of Dana Root, PT, CPE of OSHA were critical to the Region V project and are greatly appreciated. The states involved include Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Key representatives and subject matter experts for the states were identified and have been involved with the project. Conference calls have been held and priorities were discussed. Small teams have been formed to work on specific strategies to move the initiative forward. The focus of the Alliance is on ergonomics and the protection of health care workers from musculoskeletal disorders, with an initial emphasis on disorders associated with patient handling and movement activities, such as tasks involving transferring, repositioning, and gait. Another goal is to share information with OSHA about the profession of physical therapy and how our knowledge and expertise might assist OSHA's mission and goals.

Sincerely,

Margot Miller, PT
OHSIG President

OCCUPATIONAL HEALTH PHYSICAL THERAPY PRACTICE ANALYSIS: EXECUTIVE SUMMARY

David J. Miller,
Department of Physical Therapy, Springfield College, Springfield MA

Kathleen Rockefeller,
School of Physical Therapy & Rehabilitation Sciences, University of South Florida, Tampa, FL

Margot Miller,
WorkWell Systems, Duluth, MN

Deidre Daley,
WorkWell Systems, Southern Pines, NC

Jennifer Pollack,
Aurora Rehabilitation Center, St. Francis, WI

Deborah E. Lechner
ErgoScience, Birmingham, AL

The role of the physical therapist in Occupational Health has grown substantially during the twentieth century. Presently, physical therapists provide occupational health services in traditional and nontraditional health care settings that include work in private practices, occupational health clinics, industry, and consulting firms. In addition, growing numbers of physical therapists provide services such as work rehabilitation, functional testing, ergonomic assessments, injury prevention and health promotion, and work/task analyses.

It is difficult to estimate the exact number of physical therapists practicing in the area of Occupational Health. One proxy may be the membership of the Occupational Health Special Interest Group (OHSIG) of the

Orthopaedic Section of the American Physical Therapy Association (APTA). Presently, over 600 physical therapists (PTs), physical therapist assistants, and students of physical therapy are members of the OHSIG. To be eligible for membership in the OHSIG, one must concurrently be a member of both the APTA and the Orthopaedic Section. Given that many PTs practicing in this area are not members of the APTA, the Section, or the OHSIG, use of this roster is likely to underestimate the number of PTs currently practicing in occupational health.

The dynamic nature of this emerging field within physical therapy and the greater social recognition of ergonomics, wellness, and prevention have resulted in an increased need for physical therapists to be effective in their practice of Occupational Health. In order to address this need, an analysis of practice is required to determine the essential features of this area of practice.

The purpose of this practice analysis was to develop an accurate description of practice in Occupational Health Physical Therapy (OHPT). A practice analysis uses scientific methods to identify the body of knowledge of a practice specialty or subspecialty. Basing curricula or certification specifications on the results of a practice analysis ensures that any content of subsequent training and assessment procedures developed as a result of the study accurately reflects the essential competencies. The authors used a national survey to conduct this practice analysis in order to:

- Investigate the practice behaviors and content knowledge required of a physical therapist practicing in an occupational health setting,
- Differentiate the unique practice behaviors and content knowledge of occupational health from those of other areas of physical therapist practice, and ...
- Explore both the clinical and non-clinical competencies expected of current OHPT practice that have not been investigated before in a single, comprehensive study.

METHODS

Survey Development

In 2003, the Executive Board of the Occupational Health Physical Therapy Special Interest Group (OHSIG) retained the firm of Knapp and Associates International, Inc. to assist with conducting a practice analysis of occupational health physical therapy. Their full report[1] is available upon request to the OHSIG.

The methodology used was consistent with the processes recommended by a number of accrediting organizations including the American Standards Institute's Accreditation Guidelines for Certification Organizations, the Accreditation Guidelines of the National Commission for Certification Agencies, the Joint Technical Standards of the American Psychological Association, the American Educational Research Association, the National Council on Measurement in Education, and the International Standard ISO/IEC 17024 for Personnel Certifiers. The design and implementation of the practice analysis involved a series of steps carried out between July 2003 and February 2005.

The OHSIG Executive Board created two committees to work with Knapp and Associates (a steering committee and an advisory committee). These committees consisted of members of the OHSIG Executive Board and volunteers with expertise in OHPT. Committee members came from a broad geographic area and a variety of practice settings. Their work included reviewing drafts of the survey, providing comments on specific survey components, and approving final documents.

The survey was also based on the several APTA documents, including the Guide to PT Practice,[2] and the Normative Model of Physical Therapist Education,[3] as well as current specialty content outlines, practice guidelines, clinical job descriptions developed for therapists practicing in OHPT, and interviews with members of the OHSIG Committees. The draft survey contained professional practice behaviors, content knowledge, and competencies deemed important to the practice of OHPT. Three major areas of practice were identified in this taxonomy: (1) Patient Examination and Evaluation, (2) Intervention, and (3) Practice Management. Within each area, subgroups of common activities were identified. Under each subgroup, a number of individual tasks were listed. Prior to actual distribution, a pilot version of the survey was shared with the members of the OHSIG committees and to a number of volunteers with expertise in OHPT. These individuals reviewed the survey to check for possible omissions, and they provided feedback about any items that may have been unclear or redundant.

In the final survey respondents were initially asked if they performed tasks as part of their practice. For those tasks performed, they were then asked to estimate how frequently (F) the task was performed and how important (I) the task was to the practice of OHPT. Five-point rating scales were developed for both F and I. The final section of the survey contained demographic items including education, years of practice, experience in OHPT, primary practice setting, and geographic region.

Survey Participants and Data Collection

Surveys were sent to all 618 members of the OHSIG. The first mailing included the survey, a cover letter explaining its purpose, instructions for completing the survey, and a stamped self-addressed envelope. To remind members to complete the surveys and to encourage a response, each OHSIG member was sent a follow-up postcard 2 weeks after the initial mailing and then an email approximately 3 weeks after the initial mailing. In addition, 100 phone calls were made to a random

sample of nonrespondents encouraging them to complete and return the survey. During all follow-up procedures, participants who had misplaced the surveys but who wanted to participate were mailed a second copy of the survey. All these communications emphasized the importance of participation to the research project and how the participant's contributions would benefit the practice of OHPT.

Data Analysis

Frequency of responses was calculated for all categories including demographics. Descriptive statistics were calculated for values of frequency and importance ratings for all tasks. To represent the simultaneous judgment of frequency and importance a Criticality Index (CI) for the tasks was calculated as the product of the scores for frequency and importance. The tasks were then rank ordered by their CI values, with the highest CI score for those items with the highest levels of both frequency and importance. Results were shared with the members of the two OHSIG Committees with instructions to review the rank ordering of the tasks by CI scores and to select a point above which the tasks should remain on the list. In a collaborative process between the two Committees members were then asked to select a point below which the tasks should be removed from the list. The next step was to determine which of the tasks between these two points should or should not be retained. The Committees chose to retain all tasks whose CI fell above minus one standard deviation (- 1.0 SD) below the mean. The final review resulted in the deletion of 6 tasks.

To establish a proposed content outline, or blueprint for a certification examination, the CI score for each task was weighted by the number of respondents who indicated that they performed that specific task. The weighted tasks were then compiled according to the taxonomy previously developed to calculate the content outline percentages for each topic and subtopic category.

RESULTS

A total of 122 OHSIG members completed the survey for a response rate of 19.7%. The demographic data are summarized in Table 1. Most of the respondents (51%) described private practice as their primary practice setting, followed by hospital outpatient with 24% and 11% in industry. None of the respondents had ABPTS certification, but 19% had certifications related to their job from another (non-APTA) organization.

The distribution of a proposed examination content outline by major practice area included: Patient Examination and Evaluation, 34%; Intervention, 53%; and Practice Management, 13%. Details of the exam content outline, including subcategories, are in Table 2. Full details of the results are available in the Knapp and Associates report.[1]

The tasks in the section on Patient Examination and Evaluation that received the highest percentages included performing functional capacity evaluations (9%), analyzing job demands (6%), performing post-offer screenings (6%), and conducting ergonomic examinations and work simulation assessments (4% combined).

The Intervention tasks with the highest percentages were in the category of Procedural Interventions (24%) and included subtopics of work conditioning, work simulation, acute injury management, transitional duty programs, and work hardening.

The highest percentage Practice Management tasks concerned managing relationships with employers (7%). This included providing services to organizations, performing organizational analysis, and promoting OHPT.

DISCUSSION AND CONCLUSIONS

This description of specialty practice describes the critical job functions for the area of OHPT. These results are based in the patient/client management model found in the APTA's *Guide to Physical Therapist Practice*[2] and help to define the components of practice unique to OHPT, and provide a substantive basis for a certification examination outline.

The extent to which the physical therapist practicing in OHPT examines and addresses the work environment and work-related duties and incorporates this information into their intervention planning, their use of work simulation and work conditioning, and the in-depth communication that must occur with other members of the treatment team helps to distinguish this part of physical therapy practice as a distinct and unique specialty. This practice analysis can provide the basis for development of specialty certification, curriculum, and critical features of residency programs.

ACKNOWLEDGEMENTS

The authors acknowledge the efforts of the members of the OHSIG Executive Board during the conception and implementation of this project. We also acknowledge the work of the two Committees that helped provide oversight to this work. Finally we would like to specifically recognize the efforts of Kenneth Harwood PT, PhD, CIE for his commitment to this practice analysis.

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Table 1. Subject Demographics

Primary Practice Setting (n=121)	
Setting	**%**
Private Practice	51
Hospital Outpatient	24
Industry	11
Other	8
Academic	6
Total	100

Number of years as PT (n=120)	
Number of years practicing PT	**%**
0-3	4
4-10	24
11-20	31
21+	41
Total	100

Percent of the work week in OHPT specific practice (n=118)	
Percentage of work week	**%**
0	5
1-20	28
21-40	15
41-60	16
61-80	6
81-100	30
Total	100

Highest Degree (n=120)	
Degree	**%**
P.T.	49
Masters (PT)	33
MHSC	3
DHSC	1
DPT	3
PhD	4
Other	6
Total	99*

On average, to how many patients do you provide individual services each week? (n=122)	
Number of Patients	**%**
0	8
1- 5	11
6-10	4
11-15	14
16-20	15
21-25	6
25+	6
Total	101*

ABPTS certification (n=72)	
Certifications	**%**
Yes	0
No	100
Total	100

Other job related certification (n=119)	
Certifications	**%**
Yes	19
No	81
Total	100

*Rounding Error

Table 2. OHPT Content Outline*

	% of total content		
	Area	Topic	Subtopic
Patient Examination and Evaluation	34		
Functional Capacity Evaluation		9	
Job Demands Analysis		6	
Post-Offer Screening and Worker Selection		6	
Emergency Care		2	
Impairment Rating		3	
Consult on Equipment		2	
Development of Job Descriptions		1	
Employer Needs Examination		1	
Work Simulation Assessment		1	
Interventions	53		
Procedural Interventions		24	
Work Conditioning			10
Work Simulation			5
Acute Injury Management			4
Transitional Duty Programs			3
Work Hardening			3
Client-Related Instruction		16	
Primary Prevention Education to Individuals and/or Groups			10
Secondary / Tertiary Prevention Education to Individuals and/or Groups			3
Management Education			3
Musculoskeletal Disorder Related Interventions		6	
Musculoskeletal Disorders Injury Reduction Programs			3
Ergonomic-related Modifications for Injured Workers			2
Ergonomic-related Modifications for General Workforce			1
Coordination, Communication & Documentation		3	
Outcomes		2	
Job Coaching		1	
Expert Testimony		1	
Practice Management	13		
Employer Relationship Management		7	
Services to Organizations			4
Organizational Analysis			2
Promote OHPT Services within Organization			1
Business Operations		3	
Business Marketing		2	
Business Planning		1	
Total	100		

foot&ankle

SPECIAL INTEREST GROUP

STAGE 0 CHARCOT

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Charcot arthropathy has historically been thought of as a chronic and progressive disease of bone and joints commonly found in the feet and ankles of neuropathic patients. Several disorders, in particular diabetes, can potentially produce Charcot joints following minor or major trauma.[1-4] Prior to the development of classic radiographic changes, patients develop an acute inflammatory response either from an acute injury or repetitive stress.[5] This stage is referred to as Charcot arthropathy Stage 0.[6-8] Bone stress injuries in this patient population are relatively asymptomatic and silent due to a loss of protective sensation, preserved function, and absence radiographic evidence of osseous destruction. The acute Charcot foot manifests as a relatively painless, warm, erythematous, edematous foot with or without a history of trauma.[8,9] The patient will usually have a bounding pulse and sensory neuropathy on exam. Patients usually do not have significant pain despite the presence of intense synovitis, fracture, and instability of single or multiple joints.[10,11] Stress fractures can occur and are infrequently diagnosed in patients with peripheral neuropathy since pain is absent and there is no apparent loss of function.[12] Patients are commonly misdiagnosed during this Stage 0 as having gout, cellulitis, or deep vein thrombosis.[8,13-16] The most important factor in potentially altering the outcome of patients with Charcot neuroarthropathy is to have a high clinical suspicion in patients who are "at risk."

This added stage helps recognize the high risk associated with acute fractures, dislocations, and sprains in patients with neuropathy. Patients with a history of previous ulcer, previous Charcot joint, or one who ambulated on markedly swollen and warm foot without significant pain immediately places the patient in the "at risk" category.

Patients with neuropathy who experience an acute sprain or contusion should be followed closely in the outpatient setting to monitor for signs of edema and/ or warmth. Weight bearing films can demonstrate joint space widening and subluxation that is not seen otherwise. Magnetic resonance imaging (MRI) affords the ability to visualize both osseous structures as well as soft tissues. Magnetic resonance imaging can assist with proper treatment decisions since it can detect bone marrow edema that occurs following bone injury but preceding radiographic destruction of bone and joints.[17]

Patients should remain under the care of a physician until all signs of an inflammatory response subside. The cornerstone of management of Stage 0 Charcot arthropathy should include early immobilization and offloading.[1,12,17-24] Judicious use of a removable walking boot, crutches, walkers, knee walkers, wheel chairs, or bed rest may be appropriate in this setting.[21,25,26] Immobilization may be necessary for 4 to 6 months or until the extremity becomes quiescent.

When trauma results in an acute neuropathic fracture the guidelines for treating diabetic patients with peripheral neuropathy are the same as patients without diabetes provided they are medically stable, have a good vascular status, and no soft tissue compromise. Although no level 1 evidence exists to guide the treatment, most authors recommend the placement of additional internal and/or external fixation, extending the normal post operative nonweight bearing period to twice normal, and being vigilant in follow up. Adjuvant use of bisphosphonates as well as noninvasive low intensity ultrasound may aid in the consolidation process. Prolonged bracing with Charcot Restraint Orthotic Walkers or Ankle Foot Orthoses may be necessary for long-term protection.[24-29]

In summary, inadequately protected fractures, sprains, and contusions of neuropathic joints are frequently the precursors of joint destruction; and early diagnosis and intervention during Stage 0 can potentially halt the destructive process prior to developing the established stages of Charcot arthropathy.

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painmanagement

SPECIAL INTEREST GROUP

PRESIDENTS MESSAGE

John Garizione, PT, DPT, DAAPM

PLACEBOS

To quote Yogi Berra, "Baseball is ninety percent mental and the other half is physical." That can also be said of physical therapy for the patient in chronic pain. The common definition of placebo is an inert substance or medical treatment performed on a subject, and the placebo effect as the response to this inert substance or treatment. The definition of placebo effect has been expanded by DiBlasi et al[1] to include the entire process that healing has on a patient, especially the doctor-patient relationship. Treatments (both actual and inert) are administered within a context and it is the context that is crucial.

In the literature, experimental procedures are compared to placebo controlled subjects. Does the experimental model always carry over to the clinic treatment of the pain patient? Understanding the patient is just as important as understanding the pathology and treatment that will be undertaken. The therapist-patient relationship is part of the entire framework of pain relief and improved function. Placebo effect does not involve fooling a patient with inactive treatments, but treatment success can be gained by the therapist's role in providing the patient with hope. This is done by not only using skill and techniques but also by preserving the interpersonal dimension of physical therapy as a humanitarian art. A clinician's words of positive attitude, friendliness, and empathy can have a positive effect on patient's health[2-4] just as a negative clinician's attitude can have a negative effect on the patient.[5]

In a *Journal of Orthopaedic and Sports Physical Therapy* Letter to the Editor one of our members stated that "nonspecific mechanisms (ie, placebo and patient expectation) have also demonstrated a profound effect on pain outcomes. For example, a placebo suggested to be a potent pain reliever has demonstrated similar analgesic properties as Lidocaine."[6] Patients who have high expectations of treatment success have better outcomes than those who do not have high expectations.[7] Humans possess a pain modulating mechanism that is nonlinear, adaptive, and responsive to both internal and external environments which can be conditioned. The response of this system appears to be determined by genetics and interactions with various environmental factors throughout one's lifespan. The adaptability of this mechanism allows for a reduction of pain as well as possibly reducing many of the physiological responses, such as inflammation and immunologic changes.[8] Perhaps, many of our treatment successes are a result of the nonspecific mechanisms that the patient brings to the treatment session as well as the therapists positive outlook. I don't know what it is specifically, but I will use everything in my toolbox that will affect a positive change in my patient.

Hope you all enjoy a great summer. - John

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LITHIUM IONTOPHORESIS FOR GOUT PAIN: A CASE STUDY

John E. Garzione, PT, DPT, DAAPM

The use of Lithium for the treatment of gout has been proposed since the 1800's when Lipowitz discovered the affinity of uric acid to lithium. He suggested using lithium carbonate therapeutically as a new solvent for stones in the bladder as many of them have high uric acid content.[1] Garrod[2] went on further to introduce uric acid diathesis for a wide range of diseases such as gout, urinary calculi, rheumatism, mania, depression, headache, and mood changes. He proposed that all of these symptoms were caused by an accumulation of uric acid in the joints, kidney, bladder, and brain. He recommended oral therapy with lithium salts for eliminating uric acid from the body by converting it to soluble lithium urate. This total theory was ill founded and Martindale[3] found that uric acid elimination was due to a misconception and there was no rational foundation to using oral lithium for the proposed conditions especially in light of the high adverse reaction profile that oral lithium exhibited. Horrobin[4] found that lithium inhibits the formation of both 1 series and 2 series prostaglandins, thus blocking the formation of both anti- and proinflammatory eicosanoids.

Lithium has been suggested by Kahn[5] as an ion to be used for Gout. His case report describes a patient who was treated for 1 weekly treatment for 4 weeks and had a complete resolution of symptoms.[6] His conclusions were questioned due to the time period of treatment where remission may spontaneously occur and his patient was undergoing other pain relieving treatments as well.

CASE REPORT

The patient is a 60-year-old female who was seen previously by me following fibrosis of bilateral total knee replacements. She requested to be seen again due to a sudden onset of pain and swelling of the right lower extremity. She arrived to the clinic walking with a walker and a step to antalgic gait partial weight bearing on the right foot. Prior to this painful occurrence, she was ambulating without aides with a normal heel-toe gait. She reported that she woke up that morning with a hot, red, and swollen first toe on her right foot making it difficult for her to walk with a VAS of 8/10 at rest and 9/10 with walking. She denied injury or any increase of activities that would have brought out this flare-up. She denied having a history of gout.

The right ankle was 1 cm larger than the left at the malleoli and the right DIP joint was .5 cm larger than the left. The right first toe was 3° F warmer than the left. The errythemia extended from her right 1st MTP joint to her right tibia extending to half of the distal length of the tibia.

Because of a high index of suspicion for gout, she was treated with Lithium Carbonate at 160 mA*min (2mA for 80 min.) with the active positive electrode placed on the right 1st MTP joint. The negative electrode was placed on the ipsolateral pretibial area. 160 mA*min was chosen due to the low electrochemical equivalent (ECE) of lithium. The ECE is the mass of a chemical that is liberated by a unit quantity of electricity (expressed as mg/coulomb). The ECE is a known constant for many compounds and can be found in standard chemical textbooks.[7]

The next day the patient reported that she was 50% improved and was able to walk 10' without her walker and 6/10 pain. She was seen by her primary care physician who ordered blood uric acid levels. She was treated again with the above described parameters and the following day was 90% better as she was able to walk with a normal heel toe gait without ambulatory aides. The following day, she was asymptomatic and treatment was discontinued. One week after the initial episode, her primary care physician called to report that her uric acid levels were elevated and that she should start a course of NSAID. The patient reported the excellent results that she received in PT and refused oral medications.

CONCLUSIONS

Although no firm conclusions can be made from one case report, clinically, it appears that lithium carbonate can be used iontophoretically in the management for pain of the acute gout flare up especially since dramatic improvement was seen before normal spontaneous recovery would have occurred.

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performingarts

SPECIAL INTEREST GROUP

PRESIDENT'S LETTER SUMMER 2008

Happy Summer! I hope that everyone is enjoying the warming temperatures!

2008 is also exciting because it is an Olympic year. One of our PASIG members, Gina Pongetti, MPT, MA has had the great fortune to work with gymnasts on a consistent basis, as well as hundreds of elite and compulsory level athletes every year. She is a former J.O. competitor, and uses her perspective as a former athlete and current PT to help specifically guide rehab, analyze injury trends as they relate to coaching and Code of Points changes, as well as help others to better treat gymnasts. Please contact Gina Pongetti at adagiogymnastics@hotmail.com if you have questions about the gymnasts that you are treating.

To help you get excited and informed about gymnastics in the months prior to the Beijing Olympics, Gina Pongetti is going to be contributing information for a little series on gymnastics that will be in each email citation blast over the next few months. There will be information about changes in the Code of Points (judging) and other interesting biomechanical challenges that gymnasts face. Be looking for that in your inbox!

Also in the upcoming months be looking for a survey in your email. The PASIG plans to update the member directory on our website and we will be looking for information from each of you. Please take the time to fill this out when you see it!

Caring for the Arts brings out the best in all of us!

Best regards,
Leigh A. Roberts, PT, DPT, OCS

FLIP INTO ACTION!

Contributed by Gina M. Pongetti, MPT, MA, CSCS, ART-Cert
Director- Performing Arts Medical Program
– OccuSport Physical Therapy
USA Gymnastics National Health Care Network
PASIG Member

Due to the enormous rise in support and public popularity of the events leading up the Olympic Games, I wanted to trigger some ideas, perspectives, and independent thinking about gymnasts and their injuries. Most of us do not, and may never, see the level of athletes that compete for the coveted spots every 4 years. However, the sport is built on progression, meaning that each athlete below these levels is developmentally on the path leading to the Elite Gymnast. So you may be treating a future Olympian!

This series of "food for thought" is meant to stimulate you to think about what you are watching during the gymnastics preliminary and Olympic events. There will be a new "thought" in each monthly citation blast for the next few months.

If you were a former high-level gymnast, this will be fun for you to reminisce and provide clinical applications to personal experience. If you are a fan, performing arts PT in general, or a former recreational gymnast, this may encourage you to return to a local gym and perform some more observation or spark some biomechanics literature searches. Either way, have fun!

Thought #1 - With the change in the Code of Points, which is the governing value system placed on each element that an athlete performs, and the way that the scores are calculated, elements/tricks become harder and harder as the years progress. Because of the increase in athletes in the "pool" for selection for Elite level as well as Olympic teams, and the increase in number of gymnastics clubs in the US, repetitions have increased in order to master skills. A great example of this is tumbling passes on floor. A gymnast used to perform 3 in each routine, and now we are at an average of 5. How do you think this is going to change the injuries that we see trickling down to the recreational level, as well as the Elite level?

MANAGEMENT OF A MUSIC STUDENT WITH THORACIC, SHOULDER, ARM AND HAND PAIN

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Most injuries in violinists found in women over 25 and are caused by overuse or peripheral nerve compromise.[1] Symptomatic violinists complain of neck and arm pain related to increased neck and shoulder muscle tension, increased thoracic kyphosis, spinal hypomobility, and poor practice habits.[1, 2]

Cervical radiculopathy can result from the sustained posture of cervical rotation and lateral flexion while holding the violin in the playing position thus narrowing the ipsilateral neural foramen and increasing the risk of nerve root irritation. Violinists are susceptible to musculoskeletal and neurologic injuries to the left upper extremity, while keyboardists tend to have injuries in the right upper extremity.[2] Most pain in music students can be attributed to long playing hours, excessive practice times, and difficult programs or technique changes.[3]

A 20-year-old female collegiate music major with a medical diagnosis of "Cervicalgia" sought physical therapy for complaints of neck and upper shoulder pain along with thumb numbness. The complaints began 2 years ago but worsened over the past couple of months limiting her ability to play the piano, violin, and dance. She is unable to practice the violin or piano for longer than 30 minutes or dance for more than 20 minutes. Her current repertoire requires daily practice of 1 to 2 hours or longer. She realized her condition was worsening as she required more frequent and longer duration rest periods between practices to allow her symptoms to resolve. Recently she has had difficulty gripping objects and noticed increased pain in her neck when studying.

Her primary complaint is a "sharp pain" between her shoulder blades (4–7/10 pain rating) with prolonged playing times and an 8/10 "stiff and achy" neck. She also reported thumb numbness with prolonged playing times. Once triggered, her symptoms will last up to 2 hours, but return to baseline after an hour rest. Previous summer physical therapy of heat, sensory TENS, general thoracic stretches, and exercises for scapular and shoulder strengthening provided temporary relief but her symptoms returned when she returned to her fall semester activities. Her current physical therapy goals are to identify the cause of her pain and minimize the pain level of future complaints. Her interest in minimizing pain in part reflects her belief that pain is an expected component of a musician's career.

Although the doctor diagnosed her with Cervicalgia, a sharp or aching pain isolated to the neck region, her symptoms extend to the upper extremity and require a differential evaluation to identify the presence of cervical radiculopathy or another neural compromise. The results of the testing are found in Table 1.

The Neck Disability Index (NDI)[5] and the Disabilities of the Arm, Shoulder and Hand (DASH)[6] were used as self-reported outcome measures. The DASH contains a sports/performing arts module assessing her ability to play an instrument adding to its value in this population. At the time of the evaluation, she rated herself as "moderately disabled" on both the Neck Disability Index, as well as the DASH (both for ADLs and performing Arts Module). We evaluated pain, cervical ROM, joint mobility, neural tension, muscle tension, and posture. See Table 2 for objective findings.

When this patient's presentation is compared to the inclusion criteria for cervical radiculopathy studied by Wainner et al,[7] a diagnosis of cervical radiculopathy was supported. See Table 3 (pg152) for comparison. In addition, our patient has a secondary diagnosis of neural involvement recreating symptoms in her thumbs.

A treatment plan was developed for this patient to address each impairment identified in the evaluation. See Table 4 (pg152) for treatment plan details. The artist was treated for a total of 13 visits. The initial treatments (visits 1-5) centered on pain management, extensive cervical and thoracic joint mobilization, and soft tissue mobilizations. As treatment progressed (visits 6-10), strengthening exercises were added for the deep cervical flexors and scapular stabilizers, and neural glides were incorporated. Her wrist and thumb hypomobility resolved by visit 10. The final stages of intervention (11-13) involved adding cervical strengthening exercises and teaching the patient self-neural glides to manage her neural tension complaints**.** Throughout all treatment sessions, patient education was emphasized for proper posture, active rest

Table 1. Differential Diagnosis

Cervical Radiculopathy Differential Diagnosis	Test	Result
Cervicalgia	Pain isolated to neck region	Pain radiated beyond neck
Thoracic Outlet Syndrome (TOS)	Adson, ROOS	(-) Adson, (-) ROOS
Neural Tension	Isolated nerve tensioning	(+) Radial, Ulnar; (-) Median
Double Crush Syndrome • Nerve Root Compression • Carpel Tunnel Syndrome	• Spurlings • Tinnel's, Phalen's	(+) Spurlings (-) Tinnel's, Phalen's
Trigger Points: Referred Pain	Palpation of UT, Lev. Scap trigger points (per Travell[4])	Recreated a pain but not "her" complaint: Interpretation (-)

Table 2. Patient Presentation at Initial Evaluation, Intervention Focus, and Progress at Discharge

	Outcome Measures	Posture	Pain	Cervical ROM	R thumb ROM	Joint Mobility	Neural Tension	Palpation	Practice Times
Initial Evaluation	DASH: 26% NDI: 22%	Rounded shoulders Forward head Increased thoracic kyphosis	Neck: 8/10 Back :7/10 Thumb numbness	Extension ↓ 30% L Rot ↓ 25% L SB ↓ 25%	↓ supination at end range ↓tt ABD	Hypomobile C2-4 T1-2 T5-7 B 1st MCP R 5th MCP Hypermobile C5-7 Recreation of Sx's at C5-6	(+) Radial – for thumb numbness (+) Ulnar	Muscle tension thru-out cervical region Trigger Points B (L>R) UT, Lev. Scap	Violin: 30 min Dance: 15 min
Intervention	N/A	Pt education	TENS HEAT	Manual/ Self Stretching	Joint Mobs	Joint Mobs	Neural Glides / Stretches	Soft / Deep Tissue Mobilization	Active rest Education
D/C	DASH: 8% NDI: 6%	Improved ergonomic postures while playing	Neck: 2/10 Back: 2/10 Thumbs: Trace	Full, pain-free in all directions	Normal supination and ABD ROM	Normal C2-4 T1-2 T5-7 B 1st MCP R 5th MCP Slightly Hypermobile C5-7	(-) Radial (-) Ulnar	Decreased muscle tension No Trigger Points	Violin: 2 hr* Dance: 1 hr* *with scheduled rest times

Table 3. Clinical Prediction Comparison for Cervical Radiculopathy

Our Violinist	Wainner's CPR
(+) Neural Tension	ULTT A ↑ Sx's
Recreation of scap pain with B max closing positions (L >R)	Spurlings A ↑ Sx's
Distraction ↓ sharp pain, but ↑ muscle ache	Distraction ↓ Sx's
Cervical ROM limited by 25%	Involved Cervical Rot < 60°
Secondary Dx of wrist tightness and neural sensitivity in thumbs	

Table 4. Treatment Plan

	Visits 1-5	Visits 6-10	Visits 11-13	All Visits
Treatments	Pain management ▪ Heat ▪ TENS Joint Mobs ▪ Cervical ○ PA's ○ Unilaterals ○ Sideglides ▪ Thoracic ○ PA's ○ Unilaterals ▪ MCP's STM / Manual Stretching ▪ UT's ▪ Lev. Scaps	Cervical endurance ▪ Chin tucks (5 sec hold x 20) Scapular Strength (3 x 12) ▪ Scap sets ▪ Tband rows ,ext ▪ Prone rows ▪ Prone hor. Abd Neural glides ▪ Radial ▪ Ulnar	Cervical strength ▪ 4 way isometrics (10 sec hold x 10) Self neural glides ▪ Radial ▪ Ulnar	Postural education ▪ Head back ▪ Shoulders down and in Active rest ▪ Short practice periods ▪ Scheduled rest periods during practice HEP ▪ Self stretches ▪ TE's added as able

(shorter practice times, practice breaks every 15 min), and proper technique with her HEP.

In addition to addressing her impairments, treatment was centered on patient education in 2 focal areas. The ergonomic posture and technique she used while playing the violin was evaluated and advice was provided. Please see photos 1 through 4 for ergonomic posture comparisons. The patient was also educated on the self-management of her symptoms with stretching to maintain body alignment and soft tissue extensibility.

As depicted in Table 1, she improved in every objective measure including pain, ROM, joint mobility, neural tension, palpation, self-reported functional levels, and was able to increase her playing and practicing times. She was independent in self stretching and identifying the need to balance practice and rest.

A combined belief of "more is better" in terms of practice and performance and accepting pain as part of music-making can prevent musician from seeking help when they are injured. It is important that musicians perceive themselves as athletes, know how to look after their bodies. Avoiding excessive practice sessions and learning self-help techniques to combat the early signs of overuse injuries can become an area of understanding and respect. Ergonomic modifications can help reduce repetitive stresses and can be incorporated into a musician's repertoire without negatively impacting performance quality.

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Photo 1.

Poor ergonomic posture – side view: Poor foot spacing, decreased arm elevation, and increased cervical flexion.

Photo 2.

Corrected ergonomic posture – side view: Staggered feet, sitting at the front of the chair, increased arm height, and more neutral cervical spine.

Photo 3.

Poor ergonomic posture – back view: Increased cervical flexion, slouching, and poor foot spacing.

Photo 4.

Corrected ergonomic posture – back view: More neutral cervical spine, upright sitting position, staggered stance.

animalrehabilitation

SPECIAL INTEREST GROUP

HELLO TO THE MEMBERS OF THE ANIMAL REHABILITATION SPECIAL INTEREST GROUP!

I hope that the "dog" days of summer don't have you down but looking forward to the Fifth International Symposium on Rehabilitation and Physical Therapy in Veterinary Medicine. This meeting, a collaboration of the fields of veterinary medicine and physical therapy, will be held in Minneapolis, Minnesota from August 13-16, 2008. In association with the meeting, which will include both clinical and scientific presentations by practitioners from the USA, Canada, Australia, the Netherlands, and South Africa (among others), there will be 2 sponsored preconference courses: one by Laurie Edge Hughes on management of the canine spine and the other by Lesley Goff on management of the equine sacroiliac joint. In addition, we hope to have a meeting of the ARSIG membership with potential for further discussion of the WCPT movement towards recognition of Animal Physical Therapy as a specialty within physical therapy worldwide. We hope to see you there! (For more information and to register, check out the website at: http://www.cvm.umn.edu/outreach/events/rehab/home.html.)

We'd like to thank those of you who participated in the Practice Analysis. We've completed the survey process and our next step is to consolidate responses and analyze the data. The SIG has hired a consultant to assist us in this over the coming months. We hope to have a fantastic document (ready for publication) as a result which will serve as a stepping stone for the SIG and our many future projects and goals.

We're very excited to announce that Carrie Adrian, our Vice President and Education Chairperson, has secured Narelle Stubbs, PT as our primary lecturer for CSM 2009. Narelle is truly a pioneer in the field of equine rehabilitation. Please plan to attend as opportunities to hear Narelle speak are few and far between. We're so very excited to be hosting her for our SIG programming.

Please do not hesitate to contact any of your SIG officers with questions or concerns, especially in your interactions and discussions with your various PT and DVM boards and state associations. We've got a fantastic State Liaison Network (but could always use a few more willing participants) and great support from the Section and APTA offices. Together we will move forward!

Best wishes for a happy and healthy summer!
See you in Minneapolis!
Amie Lamoreaux Hesbach, PT

PS: FINALLY, the second installment of Jennifer Brooks' fantastic article!!! The first part of this article was published in the January 2008 issue.

Intermittent Upward Fixation of Patella (IUFP) in the Horse: Part II: An Equine Case Study

Jennifer H. Brooks, PT, MEd, CERP

Jennifer Brooks PT, MEd, CERP received her Equine Rehabilitation Practitioner certification from the University of Tennessee in 2006. She is the sole proprietor of Equine Rehabilitation Services, LLC. She treats both humans and horses in the New England area.

HISTORY

Patient was a 14-year-old gelded male horse used primarily for pleasure riding. The owner's chief complaint was a 3-year history of progressive periodic episodes of lameness. The owner noted an increase incidence of "clicking" of his stifles and multiple episodes of the horse tripping. She reported that he had had several episodes of the bilateral hind limbs "giving out" and "locking up" causing his hind end to collapse while she was riding him. She had decided not to ride him anymore for his and her safety. She kept him in stall rest to prevent further episodes of his stifles locking up. Two veterinarians had confirmed the horse to have "locking patellae" by observation only. No other diagnostic measures or blood work had been done.

EVALUATION FINDINGS

Upon visual inspection, this horse presented with poor body condition of approximately a 4 out of 6 point condition-scoring, for being 50 pounds over weight on a medium to small frame. When viewed from behind and from the side, there was significant bilateral hollowing in the area of quadriceps femoris, tensor fascia latae, and bicep femoris musculature area indicative of atrophy. Audible clicking was noted of bilateral stifles as the horse shifted weight on to and off of hind legs in preparation of locomotion. A visible "jump" of the patellae was noted bilaterally upon each step the horse took. Quadriceps and bicep femoris muscle fasciculations were noted after this horse was asked to move and then stand still. No stifle intracapsular joint effusions were noted upon manual palpation of both joints, but the horse exhibited pain responses indicting tenderness was present in bilateral stifles upon this palpation. No crepitis was noted upon passive movement of patellae or with passive weight shifting of hind end. No other outstanding findings were noted regarding the musculoskeletal system

or confirmation faults other than a lax abdominal musculature and weakened topline (epaxial muscles of back and neck) and general under development, common to the out-of-work condition.

DIAGNOSIS

Chronic intermittent upward fixation of patella bilaterally (with report of occasional upward fixation of patella)

PROBLEMS

1. Atrophy of hind end musculature.
2. Pathomechanics of stifle.
3. Pain.
4. Dysfunctional mobility of locomotion for pleasure riding use.
5. Risk of articular cartilage damage to stifle.
6. Decreased proprioception possible cause for "stumbling."
7. Generalized decondition of topline muscles and abdominals.
8. Excess body weight.
9. Lack of owner education of stifle pathomechanics and dysfunction.
10. Increased expense to maintain horse when not doing his job as a pleasure riding horse.

TREATMENT OBJECTIVES

1. Strengthen hind end musculature surrounding the stifle to optimize patella mechanics.
2. Increase overall conditioning of hind end, abdominals, and topline: muscle strength, motor control flexibility, proprioception, and coordination for synergistic muscle use for safe locomotion and riding.
3. Decrease joint pathomechanics to prevent cartilage wear of joint surfaces.
4. Educate the owner re: IUFP pathology and treatment approaches.
5. Decrease pain.

MEASURABLE GOAL

Reduce number of audible and palpable "clicks" from 12 out of 15 upon attempted weight shift movements to 2 "clicks" out of 15 within a 4 to 8 week period.

TREATMENT METHODS AND RATIONAL

Increase Activity Level

Avoid stall rest. This horse needed more continual movement for contraction of the muscles surrounding the stifle joints. Encouraging the horse to walk around the pasture promotes hip and stifle musculature to use all of the following contractions types: isometric holding, isotonic contracting and relaxing, and eccentric control into decelerating and lengthening contractions throughout the various gaits and transitions. Putting the horse out to pasture with a buddy or with herd will promote constant roaming in a herd-like fashion. Hay should be placed about the paddock in several locations to encourage the horse to move from pile to pile. Slopes and hills are ideal to have in the pasture for encouraging all of the above with the added effect of gravity and deceleration control. If there is fear of injury from other horses that are wearing shoes, a companion pony, Miniature horse, or a goat, can be a fine companion to keep the horse moving about the pasture.

Ideally a paddock and stall combination with direct open-door turnout is best. The horse can come in from elements as needed and return out doors to roam frequently. Constant indoor box stall confinement with little turn out or for riding only is the least ideal situation for horses with IUFP. This inhibits the true nature of the horse from doing what nature intended, which is to roam many miles, while foraging for food. If it is necessary to stall board a horse with stifle problems, it is essential to instruct the owner, trainer, and barn manager to turn the horse out as much as possible during day or night. Sometimes the horse can be set free in the indoor arena for the evening hours. In the most optimal of situations horses should have an access of at least an acre per horse of varied terrains, providing both grazing and pasture for exercise to mobilize the horses' muscles and joints on a daily basis.

STRETCHING OF TIGHT STRUCTURES

Flexibility of the surrounding hip and stifle is important for maintaining full range of motion, proper skeletal alignment, and correct biomechanics. Tight muscles or soft tissue structures can cause pain, weakening of that tissue, or contribute to abnormal biomechanics of surrounding joints. Flexibility stretching is the ability of muscle or soft tissues to yield to a stretch force.[1] Sharma et al 2005, indicate stretching has been shown to increase collagen synthesis and improve collagen fiber alignment, resulting in higher tensile strength of tissues.[2,3]

The owner of this horse was already doing some basic hind limb stretching techniques of the basic muscle groups surrounding the hip and stifle joints by passively bringing the limb forward under the horse's belly stretching the posterior hamstring group (semitendinosus and semimembranosus) and gluteals and biceps femoris. Bringing the limb into combined stifle and hock flexion

towards the posterior of the horse stretches the tensor fascia latae and the quadriceps femoris, sartorius, and possibly psoas major and minor.[4] Continuation of stretching exercises was encouraged with instruction of additional methods of stretching into abduction and adduction and lengthening the time in which the stretches were held.

There are many texts written about equine stretching with good instruction for stretching of limbs, neck, and trunk. The deficit of these instruction manuals is the absence of the proper length of time to hold a muscle in the stretch that is known to provide the desired physiological lengthening of the fascicles. Bandy's acclaimed research suggests that maintaining passive stretches of 30 seconds is most optimal.[5] This research indicates that change in flexibility appears to be dependent on the duration and frequency of stretching.[5] Therefore the owner was instructed to hold the stretches longer (she was holding for only10 seconds) to 30 seconds as tolerated to get muscle relaxation and physiological lengthening, allowed a rest, and then repeated 3 times each stretch. These stretches were repeated daily to all muscle groups as tolerated.

STRENGTHENING EXERCISES

The significant atrophy of this horses' bilateral quadriceps and biceps femoris muscles was the probable reason for the faulty biomechanics of the stifle-patellae complex. Therapeutic exercise was the primary treatment of choice to address the disuse atrophy. A regime of motor control relearning and progressive strengthening was initiated soon after evaluation. This began with weight shifting exercises, promoting co-contraction around the stifle and hip musculature facilitated by the manual cueing facilitation techniques commonly known to physical therapists. In-hand work of backing, walking, and trotting on (firm to soft) terrains, up and down gentle hills was initiated. This progressed on to more strenuous exercises of long lining, large circle lunging, and round pen work. Degree of difficulty was increased by transition emphasis in and out of walk, trot and canter, and then progressing onto riding under saddle, starting on firm surfaces working towards more unstable surfaces. All of these use isotonic control with emphasis on eccentric control via downward transitions. The following techniques are not evidence based, but come from the author's experience as a physical therapist, horse owner, equestrian, and certified equine rehabilitation practitioner.

MULTIPLE ANGLE SUBMAXIMAL ISOMETRIC EXERCISES

Weight shifting exercises can elicit isometric and co-contractions of the horses weakened muscles surrounding the stifle joint. This can be done in the following 2 methods. The horse stands in both squared-up and out of square positions for the multiangled strengthening to occur.

1. "Tail Pulls" to one side-The tail is an easy object to grasp to impose a weight shifting. Caution should always be used in close proximity to the horse's hind end to avoid being kicked! Gently pull the tail to one side. This imposes a weight shift to that side, facilitating contraction of the quads, TFL, and bicep femoris muscles for stabilization of the hip and stifle. Hold for 10 to 20 seconds as tolerated, release, and repeat several repetitions, on each side as tolerated. The horse can be eating a meal or grazing while performing this exercise. If the horse objects to the tail pull, the therapist can use manual cueing to shift weight in the direction of the involved limb. The horse can be positioned in the squared-up position of all 4 legs directly underneath or unsquared with legs placed in a variety of positions to address multi-angled directions of muscle facilitation.

2. To increase the isometric demands of these muscles, one can advance this exercise to have the horse shift its weight totally onto the affected limb by picking up the opposite hind leg or the diagonal forelimb. Continue in a variety of leg positions for static holding co-contractions for 10 to 20 seconds as tolerated. Controlled weight shifting perturbations can be alternated, repeating as tolerated.

ISOTONIC (DYNAMIC) EXERCISES

Isotonic exercise involves the concentric (shortening) and eccentric (lengthening) muscular contractions that result in movement of joint or body part against a constant load.[1] The load (resistance) of isotonic exercise is the constant of gravity pulling on the horse's body and limbs while in locomotion. Resistance is constantly being applied to muscles as they shorten or lengthen. Resistance can be increased by using hills, water, a rider on the horse's back, or pulling a cart. Below is an example of a protocol for progressive strengthening a program.

IDEAL PROGRESSIVE REHABILITATION PROTOCOL FOR STIFLE WEAKNESS

1. Backing in hand: start with short lengths of 10 ft on level ground, for 5 minutes intervals, as tolerated. Daily for 1-2 weeks.
2. Walking up and down hills in hand-start gradually with 5 minute intervals up to 15 minutes daily as tolerated. Day 4 for 2 weeks.
3. Walk trot transitions "in hand" – Day 7 for 2 weeks. Decelerating transitions going from trot to walk requires emphasis on eccentric control of the quadriceps muscles.
4. Lunging activities: week 4 using a long line or a posoa, both with full tack, bit, and bridle. This technique encourages abdominal muscle recruitment, lengthening of epaxial (paraspinals) muscles for development of proper self carriage, proper movement patterns, and better

propulsion from the hind end. Large circles are best to avoid increasing torque stress on the stifle. Lunging a horse with halter and rope encourages a hollowed shortened back and poor dynamic balance encouraging improper motor control training in less than ideal posturing.

5. Transitions up and down throughout the 3 gaits will encourage the horse to come up under himself and rounding throughout the top line thus encouraging proper use of his hind end into a more flexed position. Downward transitions require eccentric contractions, essential for conditioning of the improved stifle function.
6. Intermittent ground poles can be introduced slowly to increase flexion of the stifle and hock while in motion. This also provides propioceptive awareness of limb placement, improving coordination of fluid movement patterns and balance reactions.
7. Riding: After an 8-week period with emphasis on the above exercise regime, there was noted reduction of IUFP and no signs of lameness, it was appropriate for a trial of the horse's tolerance of rider on the horses back. The horse was able to withstand the weight of a rider and to continue to do conditioning under saddle, of slow progression of W-T-C. Continuation of the above exercises were done under saddle (rider on the horses back): Transitions up and down at all 3 gaits, lateral work, up and down hills, backing up, pole work, slowly progressing towards caveletti work, etc.
8. Educate the owner: Education regarding the horse's injury, pathomechanics, pathophysiology, and treatment rationale is essential for the owner to understand, accept, and participate in the overall rehabilitation process. Many of the above treatment approaches can be explained and taught to the owner for frequent application of treatment when the therapist can not be present. More frequent intervention by the owner benefits the horse's overall condition for a faster optimal recovery.

OUTCOME MEASURES AFTER 8 WEEKS OF INTERVENTION

1. Reduced audible clicking in bilateral pelvic limbs 2 or less times out of 15 steps.
2. Increase in hind end muscle hypertrophy by subjective visual estimate of approximately 50%.
3. Improved flexibility-although goniometric measurements were not taken in this horse, the horse exhibited improved tolerance to stretching program with increased freedom of movement of limbs.
4. Improved condition of horse-horse exhibited increased endurance of exercise program, able to exercise in 50 to 60 minute intervals without signs of stumbling, lameness, or cardiopulmonary distress.
5. Owner felt comfortable and confident riding horse on all terrains, 2 to 5 times a week, at all gaits without reoccurrence of "giving-way" of stifles.
6. Owner understood pathology and treatment approaches. She followed the prescribed therapeutic exercise regime faithfully to achieve the success this horse experienced during rehabilitation.
7. No pain responses detected upon stifle palpation.

RESULTS

This horse experienced a significant reduction of audible "clicking" of the patella after 8 weeks of the above prescribed exercise regime. The horse exhibited no pain response to palpation of stifle joints. He had no lameness. His strength and endurance had improved enough to carry his rider at Walk-Trot-Canter and on trail rides for 50 to 60 minute jaunts without evidence of fatigue. The owner was delighted to be riding him again and to feel safe on her mount.

FURTHER RECOMMENDATIONS

1. Consultation with a vet:
   a. Consider taking radiographs (further diagnostic tests) to rule out degenerative changes or malformations of the stifle joint.
   b. Possible prescription of anti-inflammatory and NSAID for pain control/reduction while horse is in rehab.
2. If equine aqua therapy facilities were available, underwater treadmill and swimming would be ideal for strengthening and overall conditioning of the musculature surrounding the stifle while unweighted to avoid joint trauma.
3. Weight reduction program. Weight stresses all joints.
4. Modality use:
   a. Ice would have been ideal to decrease inflammatory response and pain of the articular cartilage abuse secondary to the repeated fixations. Unfortunately the stifle is a difficult joint to apply ice to in a prolonged 20-30 minute treatment. Could try ice massage directly to the stifle for 5 minutes **--be wary not to get kicked!**
   b. Ultrasound and/or laser to decrease pain and increase healing factors.
5. Abdominal and pelvic recruitment exercises: such as rounding response and carrot stretches in to spinal flexion patterns to further engage hind end muscle function into pelvis, back, and abdominals.

6. Equine Massage: Often muscle guarding occurs secondary to joint pain and dysfunction. Massage increases blood flow, decreases muscle guarding, and promotes relaxation while undergoing rehabilitation.
7. Suggest the use of nutraceuticals products, such as glucosimine chondrotin, for the promotion of joint cartilage production and repair.
8. Cart pulling/driving. If a horse is tolerant and trained for driving this can be an appropriate method for strengthening the quadriceps and surrounding synergistic muscles with out increasing vertical compressive stress on joints.

PROGNOSIS

The prognosis of IUFP for return to athletic function is very good in horses that respond to rehabilitation exercise. However the problem may return if regular exercise ceases. After rehab intervention, persistent joint problems are very uncommon. In this horse's scenario there was no crepitis or obvious swelling noted, usually indicative of articular cartilage damage; therefore his prognosis was especially good.

DISCUSSION

Physical therapists have much to offer in the realm knowledge, and education, along with expertise practice for the treatments of injury and rehabilitation, promoting the best recovery of animals after catastrophic injuries. Education of the animal's owner is first and foremost the significant objective to achieve. This case study scenario presented a common human error to want to stall rest an injured horse in prevention of them hurting themselves further. This is widespread misconception, especially in the realm of IUFP. The owner did not understand that the pathology of this dysfunction was specifically linked to the horse's poor condition of muscle atrophy. Therefore educating the owner about the pathophysiology was important so that she understood that constant movement and progressive exercise was essential for the recovery potential of her horse.

The role of modality use was not heavy in this case scenario. In other traumatic equine conditions, modalities can play significant roles in recovery. Modalities of heat and ice are significant for the reduction of pain, swelling, and muscle spasm. The role of ultrasounds, laser, electrical stimulation, are well supported by research for the potential to increase healing of all soft and bony tissues. Therapeutic ultrasound, pulsed electromagnetic fields, and low level laser therapy have been shown to increase collagen synthesis in fibroblasts, thereby increasing tensile strength of tissues.[2] Exercise of stretching and strengthening exemplified the significant role in this horse's recovery to wellness. In rat studies conducted by Coutinho et al, stretching has shown reduction of muscle atrophy and induced hypertrophic effects in control muscle.[6,7] Strengthening supportive muscle will aid in shock absorption and increase in strength and general condition that can minimize fatigue related injuries.[10]

The role of propioceptive training can not be overlooked when treating the equine. The feed forward and feedback loops of facilitated neuromuscular control apply to this horse's strengthening and motor relearning progression. Deficits in neuromuscular reflex pathways as a result of decreased proprioception have been shown to have a detrimental effect on joints. Proprioceptive rehabilitation to facilitate dynamic joint stabilization is thought to improve the neuromuscular control mechanism.[6] The more the horse was left to stand idle in a stall the more he atrophied and the greater joint dysfunction occurred. Once this horse was in treatment, progress continued on a positive incline towards greater function, allowing this horse to not only carry himself properly without stumbling but providing a safe ride for his owner. The area of propioceptive neuromuscular facilitation is where PT expertise is compared to no other equine practitioners, as PTs are experts in the study of movement science.

In consideration that some horses are not prescribed the proper rehabilitation treatments to address IUFP, or may not respond favorably, there will be some horses subject to sclerosing injections or surgery of the MPL. With the stifle joint of a horse's hind limb being analogous to the human knee, it can be extrapolated that stifle surgeries may induce "reflex inhibition" of the quadriceps and surrounding muscles. Reflex inhibition of the human quadriceps is known to occur secondary to edema of the knee joint and joint capsule stretch receptor responses, therefore making the muscles unresponsive to the neuromuscular efferent message to "contract," furthering the disuse atrophy. Cutting or fenestration of the medial patellar ligment of the horse of which sartorius, gracilis, and the quadricep muscles tendons attach, would certainly propose the possibility that reflex inhibition may follow and therefore could provide some delay of the horses return to optimal functional outcomes. Physical therapy intervention of modalities and motor relearning exercises are ideal for promoting a faster return of functional mobility after surgery of MLD or mild cases of UIFP. It is this author's opinion that if a horse is to be stall rested after medial patellar desmotomy or fenestration, it would benefit from receiving the regiment outlined above, to improve the outcome and prevent reflex inhibition and muscle disuse atrophy commonly associated with postsurgical prescribed stall rest.

LIMITATIONS OF THE CASE STUDY

The most significant limitation in this study is lack of objective measures. The stifle is a difficult joint to measure circumferentionally due to deep landmarks submerged with in heavy surrounding muscles, making it difficult to palpate on the horse. When working near horses back legs, one should always be careful of their potential to kick! Therefore muscle atrophy was judged on a subjective visible observation rather than objectively measured circumference

that would have been indicative to identify muscle hypertrophy. Another way to have measured this would have been by total circumferential measurement around the horse's entire hind end in the horizontal plane at the level of the stifle joint, coursing the areas of quadriceps and bicep femoris muscles encompassing the entire width of the back end. This would have to be done very specifically to keep measuring consistent. Lack of protruding land marks promotes greater intra/inter-rater error.

Horses are not applicable to perform manual muscle testing on, therefore muscle strength needed to be assessed in terms of functional biomechanical performance (such as how many times the patella fixates within a set distance of locomotion), muscle bulk, and endurance performance. Other areas of objective measures that would have been beneficial would have been to take goniometric measurements of the stifle joint and changes in stride lengths of hind limbs.

Treatment duration consisted of an 8-week period. The owner was instructed to continue with rehab regime in anticipation of regaining all musculature return within 6 months. Optimally it would have been ideal to have continued contact with this horse's progress for a 6-month period to document if this horse regained all muscle mass with resolution of all UIFP symptoms.

There has not been much in the realm of rehabilitation offering for animals up until the last two decades. Much of what is practiced treatment on animals has not been based on research driven evidence. Equine treatment approaches prior to the recent years has been anecdotal and based on old fashioned "folklore" of unsubstantiated remedies with out any evidence of proof as to how they may work to increase healing. There is a need for more evidence-based practice in the world of animal PT. Therapists need to incorporate the translation of evidence into the clinical practice of animal patient management. Crusading PTs that are practicing on animals need to continue to follow "the human" clinicians in the realm of developing clinical practice guidelines for management of all common animal pathologies to make the profession of PT a substantial contribution to the world of animal health and rehabilitation.

Physical therapy has much to offer the creatures of the animal kingdom. We are only now leaving the infantile stages of this developing field of animal rehabilitation and moving into an age of connecting the research of what we know is healing for humans, onto animals. There have been decades of political and territorial uproar over this movement, but as with all up heavals, views are now changing towards acceptance. Many states are adjusting their practice acts by using nonspecific human references (thus allowing all species to be treated), and developing educational requirements and practice regulations. These positive changes in each state's PT practice acts should support PT liability coverage when working on animals. Now is the time for PTs to pursue research studies to bring the evidence to support the practice: practice evidence-based physical therapy on animals to support beliefs that we are providing them the best treatment possible. Animals get hurt and have the potential to heal as well as humans. Why shouldn't we be treating them to promote their optimal recovery free of reoccurrence, chronic pain, and disability?

CONCLUSION

Many horses struggle with stifle dysfunction. There is a wide variety of reasons for these problems. The most common of these is muscle weakness due to lack of conditioning and poor conformation. The best approach for addressing this debilitating condition of muscle weakness of the hind leg is to use an interdisciplinary team of equine practitioners especially an experienced PT. The PT plays a pivotal role within this team as a rehabilitation expert, providing the optimal treatment for a horse's recovery from biomechanical stifle dysfunction. The most rewarding aspect of physical therapy is working with patients, humans, and animals alike, to help them regain their preinjury health status and return to function. In the case of the equine, this means both the owner and practitioners involved feel confidant in the horse's well being, in the absence of signs of distress, pain, or dysfunction, allowing the owner confidence to ride/work the horse for pleasure or competition.

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The Orthopaedic Section offers many opportunities for members to become involved. Please visit the Orthopaedic Section's web site at: http://www.orthopt.org/policies_and_covers_mbr.php for more information on our Board of Directors, Committees, and SIG positions.

If you are interested in serving on an Orthopaedic Section Committee, please contact Terri DeFlorian at the Orthopaedic Section office at: tdeflorian@orthopt.org.

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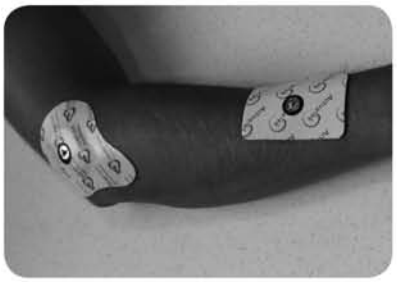

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