ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

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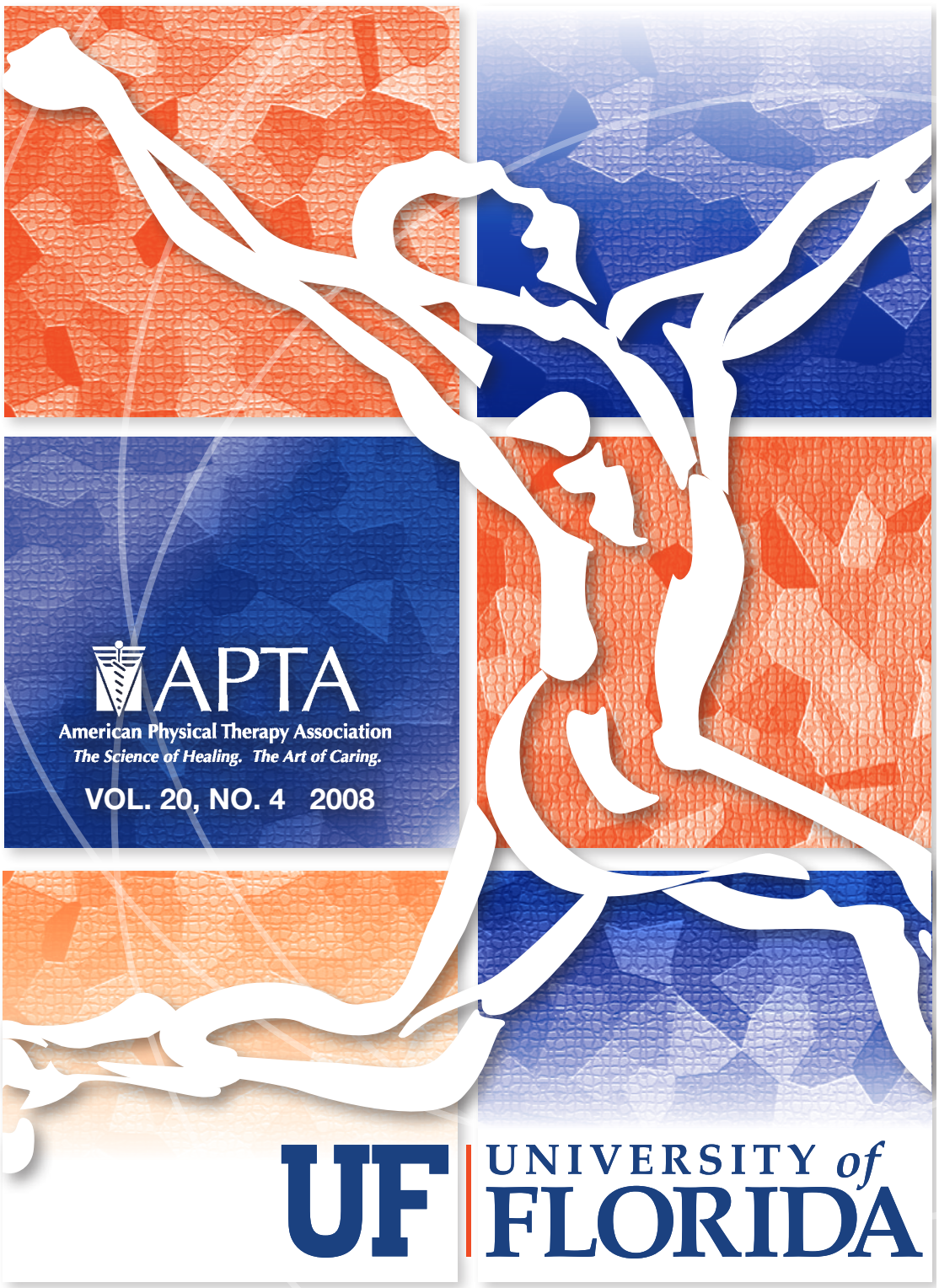

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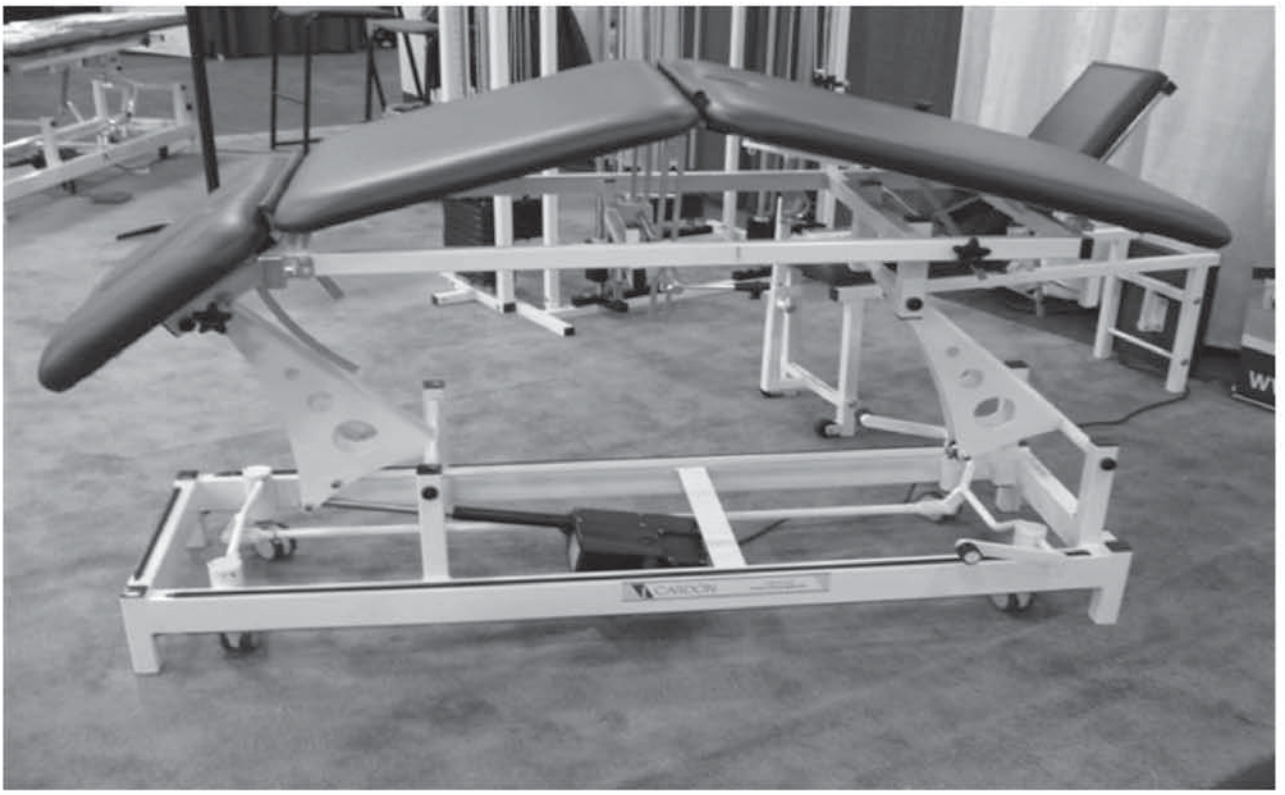

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ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

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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.

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Steven Z. George, PT, PhD[1]

It Came From the Swamp: Gators Answer the Call

Earlier this year, Chris Hughes issued a call for faculty-student papers that "represent the best-of-the-best from PT programs across the country."[1] I am responding to this call with manuscripts from students in the Doctor of Physical Therapy (DPT) program at the University of Florida. These papers represent the culmination of their evidence-based practice sequence and it is my pleasure to present them to readers of *Orthopaedic Physical Therapy Practice (OP)*.

In our curriculum, a class in evidence-based practice is taught once a year during the 3 year DPT program. The overall goal of this class sequence is to encourage students to be active learners, as well as 'critical consumers' of the professional literature and their own clinical practice. The emphasis of this sequence is on the interpretation of information from the peer-review literature. However, the final class meets after clinical affiliations providing students the chance to collect their own data from patient encounters. Students are then given two options for completing a final project that consists of a scientific poster presentation and a professional quality manuscript. The first option is a traditional case report, where students collect detailed information on one patient.[2,3] The second option is a case series, where students collect focused information on a group of patients.[4] The primary expectations for the manuscript are that it follows an evidence-based practice model and allows for student reflection on future direction in research or clinical practice.

I would like to stress that the papers in this issue of *OP* are student led projects, probably accurately described as "student-faculty papers." The DPT students were primarily responsible for generating the idea for their project, but were allowed to seek faculty input and/or use existing faculty resources as appropriate. The students were also responsible for arranging data collection with clinical instructors, writing the manuscript with assistance from a faculty mentor, determining authorship of the papers, and presenting a scientific poster related to the paper. In the case of those selected for submission to *OP* the students were responsible for meeting formatting requirements and responding to comments from the Editors. I fully acknowledge that successful completion of this project was a lot of work for the students, but invariably the feedback about the learning experience was extremely positive. As a faculty member it was rewarding to have students write about their experiences of applying evidence-based practice and to observe student progression from novice to expert on their particular project.

This year the students emerged from the Swamp with enough high quality manuscripts so that we could forward 9 to *OP*. All were eventually considered appropriate for publication by the Editor, with room for 6 to be published in this issue. In the traditional case report category there are papers describing utilization of existing treatment based classification systems for an adolescent with low back pain and a herniated disc; identification of the potential influence of hand dominance on upper extremity outcome measures; and changes in physical impairment, psychosocial factors, and function for a patient with knee osteoarthritis. In the case series category there are papers describing the association of leg length discrepancy with pain and function for patients scheduled for joint replacement; the association of fear of pain and self-efficacy with function for patients with knee injury; and the investigation of a fear-avoidance model for patients with foot and ankle pain. In subsequent issues of *OP* be on the look out for case reports from University of Florida students describing how outcomes were affected by removal and addition of cervical traction to a treatment program; changes in psychosocial factors from pre- to postoperative status for a patient with multiple knee ligament injuries; and identification of a pelvic stress fracture using existing clinical guidelines. These students are to be commended for their efforts in producing manuscripts that provide a critical look at specific components of clinical practice.

I would like to thank Chris Hughes for providing *OP* as an outlet for high quality student led work that normally might not be disseminated in our professional literature. As a result, I believe this call be a benefit to student, faculty, and clinical readers. His call also provides an opportunity to benefit from observing how different environments handle faculty-student (or student-faculty) collaborations, an important topic as we evolve into a doctoring profession. I would also like to thank all University of Florida faculty members who have served as mentors for these evidence-based projects because although it is a rewarding experience, I realize it is also a time consuming endeavor. Mark Bishop and Terri Chmielewski deserve special recognition not only for their continued mentorship of these evidence-based projects, but also for their tremendous efforts in shaping our orthopaedic curriculum over the last 5 years. I hope the readers of *OP* enjoy these papers from the recent University of Florida (2008) DPT class and, again, I greatly appreciate the opportunity to showcase their work in *OP*.

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president'smessage

James J. Irrgang, PT, PhD, ATC

I hope that you have had a safe and enjoyable summer and that you found time to relax with your family and friends. With return to school and the start of the football season, the Fall is like the beginning of the New Year. Over the summer the Section Office and Board of Directors have continued to work diligently for the benefit of Section members. The following is an update on Section activities and achievements of our members.

This past year, the Section increased the amount of money available to Section members to support research related to orthopaedic physical therapy. This increase in funding lead to receipt of an increased number of high-quality applications. After review by an ad hoc grant review committee, the Section awarded 3 research grants of approximately $25,000 each. The recipients of the grants are:

- Susan Saliba, PT, PhD, ATC for a project entitled "The Effects of Trancutaneous Electrical Nerve Stimulation as a Disinhibitory Modality in Patients with Tibiofemoral Osteoarthritis" $25,000
- Todd Davenport, DPT, OCS for a project entitled "Ankle Manual Therapy for Individuals with Post-Acute Ankle Sprains: A Randomized, Placebo-Controlled Trial" $25,000
- Scott A. Biely, PT, DPT, OCS, MTC for a project entitled "Validation of Clinical Observation of Aberrant Movement Patterns in Patients with Mechanical Low Back Pain" $24,375

We congratulate these investigators on the receipt of research funding from the Section and look forward to the results of this research and its contribution to orthopaedic physical therapist practice. Applications for the 2009 Orthopaedic Section research grants are due November 15, 2008. For more information on the application and review process, please visit the Section website at www.orthopt.org/downloads/grants.pdf.

The American Physical Therapy Association has initiated a process to revise the Clinical Research Agenda, which was last published in 2000. The Clinical Research Agenda that was published in 2000, focused on questions related to the patient/client model and as such was perceived to be exclusionary by some because it did not address their area of research. For example, it was perceived that questions related to basic science or health policy research were not included in the agenda. To address the shortcomings of the Clinical Research Agenda, the APTA has expanded the scope of the Research Agenda to include basic science, clinical, clinical practice/health services, health policy, and educational research. APTA has requested the Sections to be involved in submitting questions for the Research Agenda that are relevant to the Section's mission.

To facilitate the Orthopaedic Section's development of research questions that can be included in the APTA Research Agenda, the Section developed a Task Force to identify research priorities for orthopaedic physical therapists in the areas of basic science, clinical, clinical practice/health services, health policy, and educational research. The response that was received to an announcement requesting individuals to serve on the Task Force was outstanding--more than 50 Section members expressed interest in serving on the Task Force. From that list, a Task Force, led by Kelley Fitzgerald, PT, PhD, OCS, consisting of 11 individuals with expertise in basic science and biomechanics, clinical trials, practice and health services, health policy and educational research was selected. The Task Force is in the process of developing an initial list of research priorities that will then be distributed to Section membership this fall to rank the priorities and to identify additional priorities that were not initially identified by the Task Force. The draft Research Agenda will be reviewed at a public hearing at the Combined Sections Meeting in Las Vegas, NV on Tuesday February 10, 2009 from 10:00 AM until 12:30 PM. All Section members are encouraged to participate in the process to develop the Research agenda.

This past year, the *Journal of Orthopaedic and Sports Physical Therapy* (*JOSPT*) published 2 clinical practice guidelines that were developed using the framework of the International Classification of Functioning and Disability (ICF). These include Clinical Practice Guidelines for Treatment of Heel Pain--Plantar Fasciitis: Clinical Practice Guidelines Linked to the International Classification of Function, Disability, and Health that were published in the May 2008 issue of *JOSPT* and Neck Pain: Clinical Practice Guidelines Linked to the International Classification of Function, Disability, and Health that were published in the September issue of *JOSPT*. These guidelines are available at http://www.orthopt.org/ICF.php. Future guidelines that will be completed within the upcoming year include guidelines for treatment of low back pain, hip osteoarthritis, and shoulder pain. Additionally, the Section is considering the development of materials that will foster the use of the guidelines by practicing physical therapists including video-based demonstration of techniques and development of examination and outcomes data collection forms. Feedback concerning the usefulness of the guidelines is encouraged and can be provided by accessing the Section website at: http://www.orthopt.org/ICF/survey.php.

There has been much discussion concerning the need to create a brand for physical therapy that accurately reflects what physical therapists do that is widely recognizable to the public and other health care professionals. In response to this, the APTA presented a summary of the work completed by the Branding Task Force prior to the House of Delegates Meeting in San Antonio. The findings from the Branding Task Force are now being used to create a comprehensive communications plan. The communications plan will include a tiered approach to implement the brand platform by sequentially educating APTA membership, other health care providers, and the public.

To position the Section for a greater role in branding and marketing of orthopaedic physical therapy, we have reinstituted the

Public Relations and Marketing Committee. The Section sent out a request for committee members and 4 individuals have agreed to serve on the committee. This fall, the Public Relations and Marketing Committee will begin to establish goals and objectives to promote the brand of orthopaedic physical therapy. I will provide further information regarding the plan in a future President's Message.

This past summer, Stanley Paris made a valiant effort to raise money for the Foundation for Physical Therapy by attempting to become the oldest person to swim the English Channel. Stanley initially attempted to swim the Channel on July 26th. After swimming more than half way, Stanley had to stop after 7 hours 40 minutes due to painful cramps of the thighs and nausea and stomach pain, limiting his ability to ingest his hourly feeding. A second attempt was scheduled September 7th to 9th but was cancelled due to weather conditions.

The Orthopaedic Section congratulates Stanley Paris, the Section's founding president, on his attempt to become the oldest person to swim the English Channel. While he was not successful, he is now the oldest person to have attempted to swim the channel. The money that Stanley raised to support the mission of the Foundation for Physical Therapy will help the profession continue towards evidence-based practice. Additionally, Stanley's efforts have promoted physical therapy world-wide and have demonstrated that much can be achieved by maintaining a fit, healthy, and productive lifestyle. We look forward to hearing Stanley's first hand accounts of his experience.

Call for Public Relations Chair

The Orthopaedic Section is looking for individuals to become involved with the Public Relations Committee.

If you are interested in serving as Chair of this committee, please e-mail Terri DeFlorian your CV at tdeflorian@orthopt.org.

BECOME INVOLVED!

Does Hand Dominance Matter when Choosing an Outcome Measure? A Case Report

Kristen V. Arrigenna, ATC, SPT[1]

ABSTRACT

Introduction: Objectively gauging changes in a patient's perceived function is done using both health related outcome measures and body part or disease specific outcome questionnaires. The purpose of this case report is to describe a situation in which the standardized outcome measure of choice did not capture the magnitude of improvement reported by a patient who was seen for physical therapy for adhesive capsulitis.

Case Description: Mrs. G was a 62-year-old female who sought physical therapy treatment for adhesive capsulitis in her nondominant arm that began 6 months prior to initial visit. Mrs. G complained of pain, decreased range of motion, and difficulty completing daily activities due to her shoulder dysfunction.

Examination: The following outcome measures were used: range of motion using a goniometer, pain using the Numeric Pain Rating scale, quality of life using the SF-12, and quickDASH to measure functional improvements.

Intervention: Mrs. G received manual therapy and therapeutic exercises including stretching, active assisted range of motion activities, and strengthening. She also completed a home exercise program.

Outcomes: Mrs. G's mean range of motion improved 38.3° in all planes. She had an 86% decrease in worst pain. Mrs. G's quality of life improved slightly but was not clinically meaningful. Her quickDASH improved by 10 percentage points.

Discussion: Mrs. G's impairment measures indicated a significant improvement in range of motion and pain even though her functional outcome measures did not show such notable improvements. The disconnect between impairment and functional measures may be due to handedness of the patient. Consideration should be given to the specificity of an outcome measure based on dominance in future research on shoulder disorders.

Key Words:

INTRODUCTION

Shoulder disorders are the third most common musculoskeletal disorder in the United States[1] and affect up to 36% of the general population.[2] Adhesive capsulitis or frozen shoulder are a common cause of shoulder disorder with an incidence of about 2% in the general population[1] and are defined as a decreased ability to move the shoulder throughout its range of motion. Abduction and external rotation are usually the most affected, with flexion also being impaired.[1] Lacking full shoulder range of motion creates difficulty in completing activities of daily living such as personal hygiene, dressing, and cleaning.

There is no known cause for idiopathic adhesive capsulitis, but there have been some risk factors identified such as female gender, age (40-60), and diabetes as a co-morbidity.[3] In addition, it has been associated with shoulder trauma and periods of shoulder immobility.[3] There are 3 stages that a patient with adhesive capsulitis goes through: a freezing stage that is very painful, a frozen stage that is painful and severely restricted, and a defrosting stage that is not painful and range of motion improves.[1] Altogether, most cases resolve within 18 to 30 months.[4] Intervention aims to reduce pain and improve range of motion and strength, with the goal being to improve function in daily activities. These interventions include corticosteroid injection, nonsteroid anti-inflammatory drugs, physical therapy, and sometimes surgery.

The physical therapy profession, moving towards evidence-based practice, has placed an emphasis on tracking functional outcomes. A functional outcome documents improvements in a patient's ability to perform their daily tasks including activities of daily living and recreation. Measured at baseline and again at follow up, functional outcomes should improve as the patient progresses throughout the course of rehabilitation.

The quick Disability of the Arm, Shoulder, and Hand (quickDASH) is an 11 item questionnaire that addresses the patient's perspective on their symptoms and physical function due to any upper extremity impairment. The quickDASH was derived from the 30 question DASH because the shorter version is less time consuming and the longer version was found to be redundant.[5] Studies have shown the quickDASH to be as valid and reliable as the original DASH, and have concluded that it is a useful tool in the clinic due to the aforementioned convenience of the shorter version.[5,6]

The quickDASH, however useful, might not be sensitive enough when testing limitations in function when the injured arm is the nondominant upper extremity. Some of the activities mentioned in the quickDASH, including carrying a large shopping bag, using a knife, opening a jar, and performing the majority of household chores are mainly performed by the dominant upper extremity. In addition, patients with injured shoulders may use compensatory techniques to accomplish these tasks. However, testing instructions say: "It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task" implying there is little to no importance of hand dominance.[7]

The purpose of this case report is to describe a situation in which the standardized outcome measure of choice did not capture the magnitude of improvement gained by a patient who was seen for physical therapy for adhesive capsulitis.

CASE DESCRIPTION

Mrs. G was a 62-year-old female referred to outpatient physical therapy by an orthopaedic surgeon for conservative management of adhesive capsulitis. The patient first remembers feeling pain in her nondominant right shoulder after making an awkward movement to swat at a bug. After a few days, her pain subsided so she

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did not seek treatment. About 3 months later the pain returned insidiously, became progressively worse, and at this time Mrs. G noticed she had a decrease in range of motion of that shoulder. Mrs. G deferred seeing a physician for another 3 months. Six months after her initial complaint, she went to her primary physician for her routine visit, and this physician encouraged her to see an orthopaedic specialist.

Mrs. G reported her pain was improving but her range of motion was worsening. She described her symptoms as "uncomfortable" at rest and felt a painful "twinge" during overhead activities such as dressing, grooming, and putting away dishes. She was taking her prescribed nonsteroidal anti-inflammatory medication and using compensatory techniques; increasingly depending on her left upper extremity to complete daily tasks.

Mrs. G rated her worst pain as 7 out of 10 on the Numeric Rating Scale (NRS). With the NRS, the patient is asked to rate his or her pain on a scale from 0 to 10, with 0 being no pain and 10 being the worst pain imaginable. In 2005, Williamson and Hoggart reviewed the research for several commonly used pain rating scales and reported that the NRS is reliable, valid, and sensitive to change.[8] See Table 1 for Mrs. G's NRS scores at 3 intervals in her episode of care: initial, midway, and final.

Active flexion and abduction shoulder range of motion were measured in standing, using a goniometer. The measurements taken at initial evaluation, as well as follow up can be seen in Table 1. Assessing range of motion of the shoulder with a goniometer has been found to have high intra-rater reliability. Riddle et al reported the following intra-class correlation (ICC) coefficients when examining healthy individuals at different time intervals: 0.98 for flexion, 0.98 for abduction, 0.99 for lateral rotation, and 0.94 for medial rotation.[9] In addition, Sabari et al reports ICCs of 0.94-0.99 for active and passive shoulder flexion and abduction, regardless of testing positions in seated or supine.[10]

To measure flexion, the patient was seated and asked to raise each arm in front of her, with thumbs up, as high as she could. The stationary arm of the goniometer was parallel with her lateral trunk and the movement arm parallel with her lateral humeral shaft, using the axilla as the axis. Abduction was measured similarly, but patient was asked to raise arms out to the side, the stationery arm of the goniometer was parallel with her anterior trunk and the movement arm parallel with her anterior humeral shaft.

Passive range of motion was measured in supine. For all measurements, the examiner--a physical therapy student–stood near the head of the table, at the side of the patient being tested. Mrs. G was asked to relax and allow the examiner the move the arm through the range of motion until there was an end feel. For flexion and abduction, the patient was asked to lay at the edge of the table with the shoulder being measured slightly off the table. The goniometer was placed as described above for active range of motion. For rotation, the patient moved toward the center of the table. The arm being tested was abducted to 90°, the elbow flexed to 90°, and a small rolled towel placed under the elbow so that the humeral shaft was parallel with the table. The examiner then externally and internally rotated the shoulder with one hand placed on the patient's forearm and making sure that there was no compensation from the scapula. The stationary arm of the goniometer was perpendicular to the floor, the movement arm aligned with the ulnar styloid process, and the center of axis was the patient's elbow.

Mrs. G was further examined and was found to have a negative cervical screen with range of motion. Tests for rotator cuff tear and impingement of the shoulder were negative. Manual muscle tests showed the patient to have a weak rotator cuff on the right and weak scapular musculature bilaterally. The patient had an abnormal scapulo-thoracic rhythm, using shoulder elevation excessively. Both pectoral muscles were found to be lacking flexibility bilaterally with the right side affected more than the left.

Mrs. G also filled out 2 questionnaires at evaluation, the quality of life health survey short form (SF-12) and the quickDASH. These were being used for functional measures. Results of these surveys at evaluation and follow up visits are discussed in the outcomes section.

These findings are consistent with adhesive capsulitis with impairments in range of motion, strength, and flexibility that were affecting Mrs. G's ability to complete daily tasks in a normal fashion. Mrs. G fits into Practice Pattern 4G: impaired joint mobility, motor function, muscle performance, and range of motion associated with connective tissue dysfunction. Furthermore, Mrs. G was in the first or freezing stage and her prognosis is good, with improvements expected from 2 weeks to 24 months.

After the evaluation, the plan of care was discussed with Mrs. G. Treatment would take place 3 times a week for 4 weeks. Mrs. G would be seen for manual therapy, exercises, and modalities to improve range of motion and decrease pain. In addition, Mrs. G would receive a home exercise program consisting of range of motion and strengthening activities to be performed once a day.

Table 1. Shoulder Range of Motion and Pain Rating at Different Time Intervals

	L initial (dominant arm)	R initial (non-dominant injured arm)	R midway	R final
AROM flex	150	110	121	115
AROM abd	180	80	95	115
PROM flex	180	115	145	166
PROM abd	180	95	110	145
PROM IR	85	35	55	74
PROM ER	95	24	60	75
Pain Rating	NA	7	2	1

Measurements taken in the left and right shoulder at initial visit, right shoulder at the 7th visit, and right shoulder at the 12th visit. Included active flexion and abduction, passive flexion and abduction, and passive internal and external rotation with shoulder abducted to 90°. Also included is the patient's report of her worst pain at the mentioned intervals.

INTERVENTION

Every treatment began with a warm up consisting of 6 minutes on the upper extremity ergometer. Mrs. G first pedaled forward for 3 minutes and then backward for 3 minutes. Mrs. G then received manual therapy while lying supine on the table. Manual therapy consisted of the physical therapy student moving Mrs. G's right shoulder passively through flexion, abduction, internal rotation, and external rotation, providing some overpressure at Mrs. G's end range. Grade 1 and Grade 2 passive oscillations were also done at this time for pain management: posterior to anterior and superior to inferior, with several one minute bouts in each direction dispersed throughout the course of treatment. After the 5th visit as Mrs. G's pain ratings decreased, she received grade 2-3 mobilizations to address the stiffness in her shoulder joint. Mrs. G also received soft tissue mobilization (STM) to release the subscapularis and pectoral muscles of the right shoulder region. Manual therapy lasted about 25 to 30 minutes. After manual interventions were performed, Mrs. G participated in a variety of therapeutic exercise activities including stretching, active assistive range of motion (AAROM), and strengthening.

Stretches included the sleeper stretch for posterior capsule tightness and foam roll stretch for pectoral tightness. The sleeper stretch involves lying in supine with the arm abducted to 90°. The patient then rolls over her arm into sidelying, placing shoulder in the scapular plane and the elbow is bent. Using the other arm, the patient puts pressure on the wrist, passively internally rotating the affected shoulder. The stretch is held for 10 to 15 seconds and repeated for 5 minutes. The foam roll stretch involves the patient lying in supine, with arms abducted and externally rotated, over a 6-inch styrofoam roll that is run longitudinally across her back for 5 minutes.

The patient also completed active assisted range of motion activities. The patient was instructed how to use a cane with the left arm to move the right arm through flexion, abduction, and external rotation in supine. To improve internal rotation, Mrs. G would stand at a wall, with her back to the wall, and using a wash cloth, she would make small circles behind her back in the clockwise and counter clockwise directions. As her range of motion and scapulothoracic rhythm improved, Mrs. G would perform another exercise where she would stand at the wall, facing the wall, and complete giant half circles. Each exercise was completed for 30 repetitions. Mrs. G also did the pulleys into flexion and abduction for 3 minutes each.

For strengthening, Mrs. G would use a Thera-Band® and gravity resisted active range of motion. She would do external rotation, adduction, extension, and rows in standing with the Thera-Band ® and flexion, scaption, abduction active range of motion to 90°. At the clinic, she received verbal and visual feedback about posture during these exercises and at home she relied on a mirror for visual feedback. Every treatment ended with a cold pack for 15 minutes to reduce pain and inflammation.

Mrs. G's home exercise program consisted of the following exercises as described above: stretches, active assisted range of motion with the cane, wall washing, and strengthening. Every exercise was completed daily with the exception of strengthening exercises completed every other day. Mrs. G reported overall compliance with her home exercise program with minor exceptions due to being busy.

Table 2 lists the interventions performed at every visit. Mrs. G did not complete every exercise at every visit due to self reported time constraints. Interventions completed in the clinic were prioritized based on equipment (ie, she does not have pulleys at home) as well as exercises she requested to review for her home exercise program.

OUTCOMES

Mrs. G was seen for a total of 12 visits over 23 days. She did not miss any scheduled appointments and reported compliance with her home exercise program. Range of motion, pain, SF-12, and QuickDASH were all measured on the first, seventh, and twelfth visits.

Table 2. Interventions

	UBE	Manual	Stretches	Cane	½ Circle Wall Wash	IR Wall Wash	Pulleys	AROM	Theraband activities	Ice
1			X	X		X			2/10/R	X
2	X	PROM + Grade 1-2 mobs	X	X		X	X		2/10/R	X
3	X	PROM + Grade 1-2 mobs	X	X		X	X	2/10/0		X
4	X	PROM + STM + Grade 1-2 mobs	X	X		X	X	3/10/0		X
5	X	PROM + STM + Grade 2-3 mobs	X			X	X	3/10/0	3/10/R	X
6	X	PROM + Grade 2-3 mobs	X	X		X	X			X
7	X	PROM + STM + Grade 2-3 mobs	X		X	X	X	3/10/1	3/10/R	X
8	X	PROM + STM + Grade 3 mobs	X	X			X	2/15/1	2/15/R	X
9	X	PROM + Grade 3 mobs	X	X	X	X	X			X
10	X	PROM + STM + Grade 3 mobs	X		X	X	X		2/10/G	X
11	X	PROM + Grade 3 mobs	X	X	X	X	X			X
12	X	PROM + Grade 3 mobs (15 min)	X	X	X	X	X	3/10/2	3/10/G	X

This table outlines the interventions Mrs. G received throughout her 12 visits. UBE = upper extremity ergometer for 6 minutes. Manual = passive range of motion (PROM), soft tissue mobilization (STM), and joint mobilization (mobs) for 25-30 minutes unless otherwise specified. Stretches = posterior capsule and pectoral stretch each for 5 minutes. Cane = AAROM flexion, abduction, external rotation. ½ circle wall wash and IR wall wash= AAROM activities described in article. Pulleys = flexion and abduction for 3 minutes each. AROM = strengthening (S/R/W = sets/repetitions/weight in lbs). Theraband = strengthening (S/R/C = sets/repetitions/color of band where R = red, G = green). Ice = cold pack for 15 minutes.

Range of Motion

Mrs. G's range of motion improved in all planes tested from the initial to the final visit. The largest change was a 51° increase in passive flexion and external rotation. There was a 50° increase in passive abduction, 39° increase in passive internal rotation, 35° increase in active abduction, and 5° increase in active flexion. The mean improvement in all planes was 38.3°.

Wies[4] completed a case series in response to a pilot study where 8 patients with adhesive capsulitis were seen for physical therapy to receive massage and a home exercise program. They chose active range of motion for flexion, abduction, and external rotation as their primary outcome measure. Patients seen for 10 visits over 14 weeks had increased flexion by 37° (SD = 12.4, p = 0.0001) and abduction by 47° (SD = 30, p = 0.0004). [4]

Mrs. G's increase in active range of motion was not as large as in the case series, however, she had only been seen for 4 weeks whereas the patients in the case series were seen for 14 weeks. Her improvement in range of motion was also meaningful to her because she stated she was finally able to put her hand behind her back and reach overhead.

When comparing the unaffected upper extremity to the affected, there was a deficit of 65° of active abduction, 35° of active flexion and passive abduction, 20° of passive external rotation, 14° of passive flexion, and 11° of passive internal rotation. The mean difference between the 2 upper extremities was 30°.

Pain

Mrs. G's worst pain score decreased from a 7 out of 10 to a 1 out of 10. This translates into an 86% reduction in worst pain. Child's et al[11] studied the responsiveness of the NRS in low back patients and found the minimum detectable change to be 2 points, whereas Mrs. G had a 6-point decrease. This large decrease in pain is clinically meaningful and Mrs. G was better able to tolerate her exercises. In addition, she states she returned to doing some activities where pain had been the limiting factor, such as putting dishes away overhead.

SF-12

The short form (SF-12) is a quality of life survey that measures an individual's self reported general health status. It was developed from the RAND Health Insurance Experiment and the Medical Outcomes Study and is a 12-item questionnaire that produces results for mental and physical health.[12] For the purpose of this case, we focused on Mrs. G's physical health. The SF-12 is scored so that it falls on the normal bell curve, with the mean in the general population being 50 (SD = 10). However, it has been found that the physical health composite score decreases with age; the mean score for ages 55 to 64 is 46.9 with a 95% confidence interval (CI) of 6.97.[13] Mrs. G's score upon entering the clinic was 46.2, at follow up 49.3, and at the final visit 52.8. These numbers imply an improvement from 0.7 points below the mean to 5.9 points above the mean for her age and gender. However, all 3 scores fall within the 95% CI so the improvement is not clinically important. All of Mrs. G's scores fit within the average range of quality of life scores for her age group.

Quick DASH

The 11 item questionnaire asks the patient to rate her ability to do 6 activities in the last week as no difficulty, mild difficulty, moderate difficulty, severe difficulty, and unable. Activities included are opening a jar, doing heavy household chores, carrying a bag or briefcase, washing your back, using a knife to cut food, and recreational activities involving the upper extremity. The other 5 questions address interference in social life and work, reporting amount of pain and tingling, and difficulty sleeping. At least 10 questions need to be answered and the sum of responses is calculated to produce a number that represents a percentage between 0 and 100. This is the percentage of disability that the patient reports due to her arm, shoulder, or hand.

Upon entering the clinic, Mrs. G scored a 20 on the QuickDASH. Mrs. G's midway and final follow-up scores were 15 and 10, respectively. Beaton et al who developed this questionnaire from the longer DASH reports a "change in patients with shoulder problem who are reporting this problem as better" at a mean of 17.8 (SD = 16.4).[5] Mrs. G's difference of 10 percentage points falls short of the 17.8 point improvement of the patients studied when developing the quickDASH.

DISCUSSION

Mrs. G was diagnosed with adhesive capsulitis and sought treatment at an outpatient physical therapy clinic. Adhesive capsulitis has been reported to have a 2% incidence in the general population.[1] In addition, Mrs. G falls into a category of possible risk factors including gender, age, and possible shoulder trauma with period of immobilization.[3] Her initial examination would most likely put her in the first stage of adhesive capsulitis, the freezing stage, which is both painful and presents with decreasing range of motion.[1]

Mrs. G received physical therapy 3 times a week for 4 weeks that included passive range of motion, massage, exercises, modalities, and instructions for a home exercise program. These interventions are consistent with the current protocol for treating adhesive capsulitis, although the 2008 Cochrane review on physiotherapy interventions for shoulder pain concludes there is evidence which indicates that "there is no evidence that physiotherapy interventions alone is of benefit for adhesive capsulitis."[2] However, this evidence was classified as 'weak' because of a lack of well-designed studies. In addition, physical therapists continue to treat these patients with the goal of preventing an invasive surgery that is more costly than rehabilitation alone. Baseline, follow-up, and final measurements were taken for range of motion, worst pain, perceived physical health, and perceived disability due to her upper extremity symptoms.

The main impairment measures, including range of motion and pain improved considerably over the course of physical therapy, with an overall 38° increase in range of motion across several planes and an 86% decrease in pain.

The functional measures, including the SF-12 for physical health and the quickDASH did not make such notable improvements as the impairment measures. Baseline and follow-up physical health composite scores for the SF-12 all fall within the average range for Mrs. G's age group. In addition, based on the quickDASH, Mrs. G only dropped by 10 percentage points in respect to her degree of disability.

Subjective reports given by Mrs. G were that she was overall pleased with her progress at physical therapy. She stated she was able to do more with her right upper extremity, including putting the dishes away, grooming, bathing, and dressing. She reports when she entered physical

therapy she was mainly using her left upper extremity, which is her dominant side, to complete these same tasks, but she was happy to be able to use her right arm in a more normal fashion.

This disconnection between impairment outcomes and functional outcomes is important because as physical therapists, we treat based on the assumption that by affecting the impairment we will be able to affect function. It is therefore warranted to look deeper into this case and the functional outcome measures chosen.

When looking at Mrs. G's individual responses to the quickDASH, she reported no difficulty with doing the following activities at both baseline and final: carrying a shopping bag, using a knife to cut food, and participating in recreational activities. She reported moderate difficulty in opening a new or tight jar at both time points. She improved from mild to no difficulty with doing heavy household chores and from unable to mild difficulty with washing her back. Mrs. G probably uses her left arm, her dominant arm to complete most of these tasks, including carrying a shopping bag, using a knife, opening a jar, and performing the majority of her heavy household chores. Consequently this may have affected the results of the quickDASH. No evidence was found regarding the reliability, validity, and responsiveness of the quickDASH when the dominant versus nondominant upper extremity is affected.

I believe the functional outcome measures chosen for this case study were a very large limitation when trying to track Mrs. G's measurable improvement. Her score on the quickDASH at evaluation did not correlate with her subjective reports of disability and neither did her final score correlate with her reported improvement. A more specific and sensitive functional outcome measure may be warranted. It is imperative that future research be done addressing handedness of patients with shoulder disorders to see if there is a difference in responsiveness of the outcome measure.

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Jennifer Balla, SPT,[1]
Steven Z. George, PT, PhD[2]

ABSTRACT

Background and Purpose: According to recent research, lumbar disc herniation in the adolescent population is extremely rare and accounts for only 0.5% to 6.8% of total disc herniations. The link between the use of pathology or a treatment based classification approach for guiding treatment has yet to be determined in an adolescent population. The purpose of this case study was to address how a modified treatment based classification system was used for guidance of determining interventions for an adolescent patient with a herniated disc.

Case Description: The patient was an adolescent male, aged 17, with low back pain and a documented herniated disc at L5-S1. No centralization occurred with repeated lumbar movements, however, he had positive results for the straight leg raise and slump test.

Intervention: The patient was instructed in neurodynamic exercises including a straight leg raise activity with progression to a slump stretch, along with a lumbar stabilization program.

Outcome: This patient attended 13 physical therapy visits over an 8-week period. He showed a clinically meaningful change in the Oswestry Low Back Disability Questionnaire, ROM for the straight leg raise, the SF-12, and pain intensity rating.

Discussion and Conclusions: Use of a treatment based classification system for an adolescent patient with a known herniated disc seems to be appropriate treatment based on the outcomes of this case report. Further research is needed to determine if this type of rehabilitation would be beneficial for a larger group of adolescents with low back pain.

Key Words: *low back pain, Oswestry Disability Questionnaire, treatment based classification, herniated disc*

INTRODUCTION

Low back pain is the fifth most common reason adults require physician visits in the United States.[1] At some point in time, 80% of the general adult population will experience some type of low back pain.[2] In adults, the causes of low back pain are hypothesized to include muscle strain, tendonitis, mechanical low back pain, herniated disc, and facet dysfunction.[2] In regards to the adolescent population, low back pain can potentially be caused by muscular, ligamentous, infectious, or congenital pathologies of the lumbar spine.[3] A collection of signs and symptoms including back pain, scoliosis, and motor and sensory deficits are usually first considered as a sign of neoplastic disease in adolescents.[3] However, if trauma or intense sports precipitates the complaint of low back pain and sciatica, a herniated disc may be the cause. According to recent research, lumbar disc herniation in the adolescent population is extremely rare and only accounts for 0.5% to 6.8% of total disc herniations.[3]

Pathology based treatment models rely on the identification of underlying pathology potentially causing low back pain to dictate treatment.[6] A specific example of a pathology based model is treatment that is based on hypothetical disc movements. In vitro and in vivo studies[7-9] have shown that lumbar extension causes an anterior migration of nuclear tissue, while flexion causes a posterior displacement of the nuclear tissue. Lumbar extension exercises may also reduce pain by decreasing the forces acting on pain sensitive tissue. Lumbar extension can transfer a compression force from the intervertebral disc and vertebral body to the apophyseal joint reducing nuclear pressure.[10] These biomechanical findings have been the basis for the use of lumbar movements, especially lumbar extension, during rehabilitation to reduce low back pain.

Several treatment based classification models have emerged that de-emphasize the importance of basing treatment on hypothetical lumbar disc responses.[11,12] These treatment approaches incorporate movement assessment with the goal of provoking a pattern of response to pain called centralization. Centralization is a phenomenon that occurs when symptoms move from a distal to proximal location during repeated lumbar flexion and extension movements. It is then recorded which direction of movement causes centralization to occur, this is a patient's directional preference.[12] For example, if a patient's pain were to centralize with flexion, a patient would be prescribed flexion based exercises, avoidance of extension exercises, and possible use of unloading exercises including aquatic therapy and de-weighting treadmill training. Treatment based classification models do not only include the identification of centralization because not all patients experience this phenomenon.[11,14,15] Currently there is evidence for several treatment classification subgroups of patients with acute and subacute low back pain, including patients likely to benefit from manipulation, lumbar stabilization, directional exercise, and traction.[14,15] Other potential patient subgroups for LBP include lumbar spinal stenosis and neural tension.[14,19]

Research on classification systems has been completed almost exclusively on adult participants, with a common age range of 30 to 60.[6,16] A recent article by Clifford and colleagues[17] was performed to see if childhood and adolescent patients could be classified using 4 categories from a previously described treatment based classification model. The most common classification for low back pain was specific exercise in adults,[16] however, with adolescents the most common classification was immobilization.[17] It is important to note that this study of

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adolescents addressed only classification of patients into a subgroup and did not look into specific interventions and their outcomes.

Children and adolescents who present with low back pain often have an underlying pathological cause.[4] It is important for the pediatric patient to undergo a careful and thorough patient history and physical examination with those results guiding appropriate diagnostic imaging studies.[1] In contrast, it is more common for low back pain to be of nonspecific causes for adults. Adult patients with severe low back pain often have no identifiable pathology. In an article by Jensen et al,[5] 98 asymptomatic adults received an MRI to determine the prevalence of abnormal findings in the lumbar spine. Of these 98 individuals, over half revealed a disc bulge at an intervertebral disk and about a quarter revealed at least one disk protrusion. Similar studies documenting false positive rates of imaging findings have not been completed in adolescent samples, so the appropriateness of treatment based classification with evidence of pathology is still open to debate for adolescents. Therefore, the purpose of this case study was to address how a modified treatment based classification system was used for guidance of determining specific interventions for an adolescent patient with a herniated disc.

CASE DESCRIPTION

History

The patient was a 17-year-old male who reported a one year history of low back pain before his initial physical therapy visit. This patient reported that the pain began following a camping trip with the boy scouts, where he pulled a tree stump out of the ground. Specifically, the patient stated that his primary complaint was sharp pain that travels down the left posterior thigh and can occasionally travel into the left calf. This patient also had an increase in pain with prolonged postures, including sitting for periods of 1 hour or longer and/or standing for longer than 30 minutes. The patient reported an exacerbation of the sharp pain in the left posterior thigh and low back symptoms following an increase in physical activities approximately 3 weeks prior to his initial physical therapy visit.

For this condition, the patient has had 3 epidural treatments and 2 magnetic resonance imaging studies, with the most current being 2 months prior to his initial evaluation. The most current MRI reveals a loss of height with a small central disc herniation at L5-S1, which impinges slightly on the central left S1 nerve root. The MRI also reveals that the anterior to posterior diameter of the lower lumbar canal is mildly small due to congenitally short pedicles.

Initial Impression

Based on this patient's past medical history and subjective report, it was our original hypothesis that because of the presence of a herniated disc, centralization would occur with repeated lumbar motions and the patient would be given interventions based on his directional preference. However, since this patient showed no strong directional postural preference in his subjective report, other options for treatment, including neurodynamic exercises and lumbar stabilization, may have to be considered if no centralization were to occur.

Examination

The patient was initially given a health questionnaire prior to the beginning of the examination to screen for red and yellow flags. Red flags are possible serious systemic diseases that may be contributing to the patient's pain and can include cancer, infection, and fracture. Yellow flags are any social or psychological distress that may prolong the patient's condition. No remarkable findings were noted with regards to red and yellow flags with this patient.

The patient completed a modified version of the Oswestry Low Back Disability Questionnaire (ODQ) as part of his initial examination. The patient's initial score on the modified ODQ was 26 out of 100 total points (26%). The patient was also asked to rate his pain based on the numeric rating scale for pain. This scale asks the patient to rate his/her pain intensity on a numeric scale from 0 ("no pain") to 10 ("worst pain imaginable"). At initial evaluation, this patient rated his average pain intensity at 6/10.

Examination of this patient was structured to start with single and repeated lumbar motions to determine the patient's directional preference. Single range of motion (ROM) movements were observed first. In standing, the patient was asked to perform trunk flexion, extension, right and left side bending, and right and left rotation. Trunk flexion and extension both reproduced patient's pain in the left posterior thigh, however, this did not return to baseline. Specific range of motion measurements were not assessed secondary to the evidence that suggests that lumbar ROM has a weak correlation with overall disability in patients with low back pain.[18] Following single movements, the patient was asked to perform repeated movements for flexion and extension (10 repetitions of each direction). Repeated flexion and extension had no effect on the patient's pain. Since the repeated lumbar motions had no effect on the patient, directionally based exercises would not likely benefit the patient at this time and alternate hypotheses were explored.

Due to the fact that this patient reported no improvement or change in his symptoms with repeated lumbar motions, further neurological and neurodynamic testing was performed. The rationale for this examination strategy was based on a case series by George[19] and a randomized trial by Cleland and colleagues,[14] who reported that patients with leg symptoms who did not respond to repeated lumbar motions and exhibit positive neurodynamic test may benefit from neurodynamic stretching techniques. For this patient, neurological testing revealed equal and intact bilateral patellar and Achilles tendon reflexes. Light touch sensation was also intact and equal bilaterally for lower extremities. Neurodynamic testing was performed, including the straight leg raise (SLR) test and slump test. A neurodynamic test is considered positive if the patient's symptoms can be reproduced or if the response on the involved side differs from the uninvolved side.[20] The SLR test has been documented as an important test for diagnosis of lumbar disc herniation and nerve root inflammation.[20] A SLR test was performed on bilateral lower extremities, which revealed a positive test on the left (reproduction of patient's pain at 30°). For outcome purposes, the range of motion obtained during the straight leg test was documented. The right straight leg raise was measured at 80°, and the left straight leg raise was measured at 30°. The slump test has been used in the literature to assess the peripheral nerves of the lower extremities, along with neural structures in the spinal canal and the connective tissues.[20] Slump testing was also performed on bilateral lower extremities, with a positive test on the left.

Flexibility testing, manual muscle testing of the trunk and lower extremities, and lower extremity range of motion were all evaluated. Bilateral ROM and MMT of bilateral lower extremities were also performed to address any deficits that may be contributing to this patient's low back pain. Specific grades for the muscle groups with a deficit and results of flexibility testing are listed in Table 1.

EVALUATION

Diagnosis

Our original hypothesis of a centralization phenomenon related to the pathology of a herniated disc was not supported by our examination findings. It was our clinical opinion that although lumbar pathology was present in this patient, he was unlikely to benefit from directionally based exercise treatment at this time. We further examined the patient to look for limitations that would allow us to tailor a specific exercise program for this patient. Based on research by Cleland and colleagues[15] in adults, patients that did not respond to repeated lumbar movements and had positive neurodynamic tests would likely benefit from a neurodynamic stretching program. Therefore it was determined that this patient best fit into a subgroup of patients that would benefit from neurodynamic stretching despite the presence of a herniated disc. This patient would undergo therapy to address the alterations in neurodynamic activities along with a stabilization program to address muscular strength deficits and prevent reoccurrence. Research by Clifford[17] has shown that adolescents with low back pain are most likely classified into a lumbar immobilization group with a focus on trunk strengthening and stabilization. Despite the lack of obvious signs for lumbar instability in this patient, it was our opinion that this would be a beneficial addition to prevent reoccurrence of low back pain.

Prognosis

According to the literature, the natural progression of low back pain is positive. Due to the lower prevalence of low back pain in adolescence, there is a lack of evidence supporting the prognosis of low back pain in adolescents. In adult patients, studies have shown that 30% to 60% of patients will recover from low back pain in 1 week, 60% to 90% will recover within 6 weeks, and 95% will recover within 12 weeks.[21] Based on our clinical opinion of this patient's age and symptoms along with our clinical experiences with other patients, it was recommended that this patient would likely require 4 to 8 weeks of therapy twice a week. Throughout this patient's episode of care, this patient was re-evaluated to monitor his progress and correctly re-categorize if necessary.

INTERVENTIONS

This patient was seen in the physical therapy clinic for 13 visits over a 6-week period. Interventions included stretching, neurodynamic techniques, and lumbar stabilization. These interventions were chosen based on the patient's deficits in muscle length, neuromobility, and core strength found upon examination. Following the evaluation, stretching and neurodynamic techniques were taught to the patient as his home exercise program. Initial stretching activities, to improve muscle length, included a prone quadriceps stretch, a supine hamstring stretch for the right lower extremity only, and a bilateral knee to chest stretch for the lumbar spine. These exercises were to be performed 3 times each for a 30-second hold, 3 times a day. This patient was first shown a slump stretch in seated position to improve neuromobility; however, he was unable to tolerate this position secondary to pain. Another neurodynamic technique was shown to the patient to replace the slump stretch. For this technique, the patient was in a supine position on the plinth. This patient was given a stretch strap to place around the foot and by use of bilateral upper extremities, the patient performed a passive straight leg raise on the left until his pain symptoms were reproduced. The patient was then told to lower the leg until symptoms subsided and perform a small 'pumping' motion, moving the leg slowly up and down in about a 5° range for 30 seconds. This exercise was to be performed twice for 30 seconds once a day. At the patient's second visit, the current home exercise program was reviewed. The patient was instructed to continue with all of the prescribed exercises and a basic lumbar stabilization program was initiated (Table 2). These specific trunk strengthening exercises were performed by the patient from visits 2 to 4 with supervision and cueing for correction of form. Upon the fifth visit, a reassessment was performed on the patient. Pain of the lower extremity had moved from a distal location to a more proximal location. The pain in the posterior thigh had diminished significantly and the straight leg raise exercise for neuromobility no longer reproduced patient's pain. The patient was instructed in slump stretch activity, as a progression of neuromobility. In a seated position at the edge of the plinth, patient's starting position was a correct upright posture. The patient instructions for the slump stretch were as follows: "slump into bad posture, next bring your chin to your chest, then straighten out left leg, return to upright posture." The patient was instructed to repeat this exercise for 20 repetitions, twice a day. Due to the patient's improving symptoms, progression of the lumbar stabilization program also occurred on visit 5 (Table 2). These exercises were to target the spinal extensor muscles, multifidus, rectus abdominus, and the obliques. The patient continued with the lumbar stabilization program and slump stretching for visits 5 through 8. At visit 9, progression of the lumbar stabilization program occurred again based on the patient's improving abilities (Table 2). Included in this group of exercises was the side support exercise,[22] shown by intramuscular EMG to be the most effective training method for the abdominal wall. This exercise has been incorporated by Brennan et al[23] in clinical testing and has shown to be an important exercise for lumbar stabilization.

OUTCOMES

For this patient, the primary outcome measures were the Oswestry Low Back Disability Questionnaire (ODQ) and the straight leg raise measurement. The

Table 1. Examination Findings

Muscle Group	Manual Muscle Test Grade	Flexibility Test	Result
Abdominals	3/5	Thomas Test	Positive
Quadratus lumborun	4-/5 (bilateral)	Ely's Test	Positive
Trunk Extensors	3+/5	Ober's Test	Negative
Trunk Rotators	4-/5 (bilateral)		

secondary measures include the SF-12 and the patient's pain intensity ratings. The primary measures were taken on visit 1, visit 8, and visit 13. Results reported on the Oswestry questionnaire have been reported to have high test-retest reliability (r = 0.99).[24] The patient's scores on the ODQ are reported in Table 3. In the literature, a minimal clinically important difference (MCID) is often reported for a standardized assessment to determine whether a significant change has occurred and for the ODQ the MCID is a 6-point difference.[24] This patient reported a 10-point change at each assessment so clinically meaningful changes were reported. At initial evaluation, a straight leg raise measurement was taken of bilateral lower extremities. According to the literature, there is high intra-rater (0.83) and inter-rater reliability (0.77) for measuring range of motion of the straight leg raise with a goniometer.[25] The patient's measurements for the straight leg raise are reported in Table 3. According to the literature, a meaningful clinical difference (MCD) for measuring the straight leg raise is greater than 12°[26] and our measurements demonstrated a change of 40°, which indicates a clinically meaningful change occurred. Along with an increase in the range of motion, an important distinction was that the straight leg raise no longer reproduced the patient's pain in the posterior thigh at the end of therapy.

Secondary measures included the SF-12 and the patient's pain level ratings. These secondary measures were taken at initial and final visit (Table 4). There is no current literature on the reliability of the SF-12, however, there is research on the reliability on the SF-36. Since the SF-36 and the SF-12 are scored in the same fashion, for this case study data from the SF-36 was used to describe our outcomes with the SF-12. The physical functioning portion of the questionnaire has been reported to have a reliable internal consistency, reported as a Cronbach's alpha (0.93).[27] The SF-36 is reported to have a standard deviation of 10.[27] A MCD can be calculated with the use of the standard deviation and the reliability coefficient. A MCD for the SF-36 would be 7.31. Our patient in this case study had a difference of 15.5, this would be considered a meaningful clinical difference.

From initial evaluation to this patient's final visit, the percentage of decrease in his current pain report was 100% (Table 4). According to recent literature, it has been documented that a minimal clinically important difference when referring to the numerical rating scale is 20%, regardless of the initial severity of the pain.[28] At initial evaluation, this patient was unable to sit for a long period of time, stand for a long period of time, and was unable to tie his shoes without reproducing his pain symptoms. At his final visit, he reported being able to sit or stand for an extended period of time without pain and was able to bend and tie his shoes without pain as well. Strength improvements also occurred in this patient from initial evaluation (Table 1) to the final evaluation. At his final visit, this patient had an increase in all muscle groups tested initially, with the final manual muscle grades measuring 5/5 for all tested muscle groups.

DISCUSSION

Debate about the most efficient way to treat low back pain has existed for a long period of time in physical therapy. The primary treatment models have been pathology based and classification schemes. In recent years, research has shown that the treatment based classification model can be successfully used in adult patients with low back pain regardless of the underlying pathology.[11] Patient with low back pain who are blinded to the knowledge of their pathology have shown no difference in outcomes compared to the patients who know about the pathology.[29] Also these patients show significantly higher general health scores when blinded to the knowledge of underlying pathology.[29] It is important to note that imaging is important for a patient that presents with red flags during the examination and evaluation portion of a treatment session. In this group of patients, it is important to rule out a more serious underlying pathology that may be contributing to this patient's pain.

However, in adolescent patients a link between pathology and the appropriate basis for treatment has yet to be documented in the literature. In our case study, the patient had a known pathology of a herniated disc and it was our original hypothesis that this patient would experience relief with either repeated lumbar flexion or extension. The pathology model concerning a herniated disc has shown that lumbar extension exercises can be beneficial in relieving pressure on the disc and therefore, pain in the low back. However, this patient experienced no relief from repeated lumbar movements, thus justifying another approach.

Based on a case series by George[19] and a randomized trial from Cleland et al,[14] adult patients with symptoms that do not change with repeated lumbar movement benefit from neurodynamic techniques. It was our belief that this type of treatment could be successfully used with an adolescent even with a herniated disc, after clinical determination that there was no nerve root compression or other neurological signs that would provide contraindications to stressing the neurological tissue.

Table 2. Interventions

Exercises (visit 2-4)	Repetitions	Exercises (visit 5-8)	Repetitions	Exercises (visit 9-13)	Repetitions
Posterior Pelvic Tilt	3 sets of 10 repetitions	Quadruped alternating arm and leg	2 sets of 20 repetitions	Prone over therapy ball alternating arm and leg	2 sets of 20 repetitions
Bridging	3 sets of 10 repetitions	Quadruped multifidus exercise	2 sets of 20 repetitions	Supine on therapy ball, alternating lift of lower extremities	2 sets of 20 repetitions
Supine alternating arm and leg movement	3 sets of 10 repetitions	Abdominal Crunches	3 sets of 20 repetitions	Supine bilateral leg lowering	3 sets of 10 repetitions
Stretches (hamstring, quadriceps, lumbar spine)	30 second hold, 3 repetitions	Trunk rotation	3 sets of 20 with 17 pound weight	Trunk rotation	3 sets of 20 with 20 pound weight
		Supine Unilateral Leg Lowering	3 sets of 10 repetitions	Side Support Exercise	30 second hold, 3 repetitions

Table 3. Primary and Secondary Outcome Measures

Primary Outcomes	Visit 1	Visit 8	Visit 13	Difference Visit 1 to 8	Difference Visit 8 to 13
ODQ	26%	16%	6%	10%*	10%*
SLR (Right)	80°	85°	85°	5°	0°
SLR (Left)	30°	70°	80°	40°*	10°
Secondary Outcomes	**Visit 1**		**Visit 13**	**Difference Visit 1 to 13**	
SF-12 (physical functioning)	37.3		52.8	15.5*	
Pain Level Ratings	6/10		0/10	100%*	

*Clinically meaningful change occurred based on MCID values
ODQ – Oswestry Low Back Disability Questionnaire
SLR – Straight Leg Raise MCID for ODQ = 6 points MCID for SLR = 12.56°
MCD for SF-12 = 7.31 points MCID for pain level rating = 20%

It should be noted that this patient required a modification of this stretch as an initial exercise secondary to pain and eventually progressed to the use of a slump stretch. It should also be noted that we did combined rehabilitation techniques for neuromobility and lumbar stabilization. It was our opinion that a combination of these 2 techniques would be most beneficial for a patient this age. Supporting this opinion was previously mentioned neurodynamic exercise articles by Cleland[14] and George,[19] along with the article by Clifford,[17] which reported that adolescents with low back pain were most often classified into the lumbar immobilization group with a focus on lumbar stabilization and strengthening. The lumbar stabilization exercises to target the spinal extensor muscles, multifidus, abdominals, and obliques were chosen for this patient based on previous clinical experience.

Based on the findings of this study, this author would use a treatment based classification system to guide interventions and rehabilitation for an adolescent with low back pain. Once red flags have been ruled out, the use of neurodynamic exercises in combination with a lumbar stabilization program appeared to be a safe and effective treatment progression. This type of classification system allows for a tailored intervention program to be developed based on an individual's presenting symptoms. We think it may be important to incorporate a lumbar stabilization program for all adolescent patients for prevention of the development of chronic low back pain.

Based on the meaningful changes in the primary and secondary outcomes with this patient, the use of a modified classification approach for treatment of an adolescent with low back pain and leg symptoms may be a viable way to guide interventions, however, we lack the proper study design to make definitive treatment recommendations. Further research is needed to determine if there is a link between pathology and treatment for adolescents with back pain or if a classification system can be used to guide treatment for adolescents regardless of pathology. This author proposes a study with a large group of adolescents with the chief complaint of low back pain. All adolescents would undergo diagnostic testing to determine whether specific pathology of a herniated disc existed, and to rule out serious underlying pathology that would exclude them from physical therapy treatment. The patients would then be randomly assigned to 1 of 2 therapists. The therapists and patients would be blinded to the fact of whether a herniated disc was or was not present, similar to the Modic et al[29] study previously cited. The therapists would then classify the patient's based on either a directional preference during repeated lumbar movements or no preference to repeated lumbar movements and a positive slump test. Based on the patient's classification, the patients would undergo matched intervention programs for an 8-week episode of care. At the end of the 8-week period, the patients would be analyzed to determine the effects of the therapy provided and analyzed to compare the effects on patient's with a known pathology of a herniated disc and patients without pathology. Follow-up imaging will also be done to determine is existing pathology showed advancements. The primary outcome measures for these patients would be the Oswestry Low Back Disability Questionnaire, pain level ratings, and the SF-12. Follow-up for the treatment would also take place at 1 month and 6 months following treatment, to determine the long-term effects of treatment on the patients.

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The Association Between Leg Length Discrepancy and Preoperative Total Joint Replacement: A Case Control Study

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ABSTRACT

Background and Purpose: Studies have found a strong association between leg length discrepancy (LLD) and osteoarthritis (OA); however, few studies have looked at LLD's association with a need for total joint replacement. The purpose of this case control study is to determine whether patients scheduled for a total hip (THR) or total knee replacement (TKR) have a larger LLD in comparison to age-matched patients seeking physical therapy treatment for musculoskeletal pain.

Methods: Over 28 weeks, a convenience sample of 40 patients referred for THR or TKR and 20 patients referred for musculoskeletal pain participated in this study. Patient characteristics including age, sex, body-mass index (BMI), medical diagnosis, and involved lower extremity were gathered from intake forms. Clinical measures included the visual pain scale (VPS), lower extremity functional scale (LEFS), hip and knee active range of motion (AROM) measurements, and true and apparent leg length measurements. The data was analyzed by performing group comparisons with ANOVA and Pearson correlations to explore associations between LLD, pain, function, range of motion, and BMI.

Results: There were no differences between the 3 groups for mean LLD. However, there was statistically significant difference in frequencies of clinically relevant LLD (10 mm or greater) across the 3 groups for true LLD ($p = .076$) and apparent LLD ($p = .020$). For all subjects there was a moderate association between true LLD and LEFS ($r = -.297$, $p = .028$) and those with a clinically relevant LLD were more likely to have higher pain and lower LEFS scores.

Discussion: There is a potential association between clinically relevant LLD and being scheduled for a total joint replacement. Further research is needed to compare different methods of treating LLD and to determine if early treatment of LLD will prevent future need of total joint replacements.

Key Words: *leg length discrepancy, total joint replacement, total hip arthroplasty*

INTRODUCTION

It is projected that the number of primary total hip replacements (THR) will increase from 208,200 to 572,100, a 174% increase, by the year 2030.[1] Leg length discrepancy (LLD) after THR has been associated with preoperative LLD, but also with many complications including nerve palsy, low back pain, and abnormal gait.[2] Furthermore, LLD has become the most common reason for litigation against orthopaedic surgeons.[2] It should also be noted that LLD is commonly experienced as it has been reported that up to 90% of the population has measurable LLD (mean = 5.2mm).[3] Given how common LLD is, one could question whether there is a meaningful association between LLD and THR.

There are 2 types of leg length, true leg length and apparent leg length. True leg length reflects the actual osseous length of the extremity, while apparent leg length takes into account soft tissue contractures as well as lumbar spine pathology possibly resulting in pelvic obliquity.[4] Studies have shown that true leg length is a more reliable measure, however, the technique requires precise identification of landmarks, which may be difficult in obese patients.[2] True leg length is determined by measuring the distance from the anterior superior iliac spine to the medial malleolus, while apparent leg length is measured from the umbilicus to the medial malleolus.[4] These measures can be performed with or without the assistance of radiography.

Many studies have used these measuring techniques to examine LLD pre- and post-THR. Despite the technique used for the THR, these studies demonstrate that the LLD after THR usually involved over-lengthening the operative leg. Specifically, the mean increase in leg length after THR has been reported to be 5.6mm.[4] Postoperative leg lengthening of more than 10mm has been associated with a vaulting gait, pelvic obliquity, and the need for a shoe lift.[5] Shoe lifts are used with LLD of up to 9.5mm and studies have found that 24% of patients required a shoe lift after THR.[2] It has been shown that LLD after THR cannot be eliminated but, through various surgical techniques, it can be minimized.

Few studies have looked at LLD preoperatively and its association with joint replacement. There appears to be a strong association between LLD of 13mm and 25mm and unilateral hip osteoarthritis (OA) on the side of the anatomically long leg.[3] In patients with OA, shortening of the extremity with the arthritic hip is expected given the loss of cartilage on both the femoral and acetabular sides of the joint.[5] Considering LLD's association with OA, correction of LLD could potentially be a preventative measure to decrease pain and delay the subsequent need for a total joint replacement. The purpose of this case control study is to determine whether patients scheduled for THR have a larger LLD in comparison to patients scheduled for total knee replacement (TKR) or age-matched patients seeking physical therapy treatment for musculoskeletal pain. It is hypothesized that because of the anatomy involved with hip OA, patients scheduled for a THR will have a larger LLD than patients scheduled for a TKR or seeking physical therapy treatment for musculoskeletal pain.

METHODS

Subjects

A convenience sample of 40 patients referred to a south Florida hospital for THR or TKR and 20 patients referred to an outpatient physical therapy clinic for musculoskeletal pain were recruited for this case control study during a 28-week period. Patients in the THR/TKR group were considered for study inclusion if they were preoperative and above the age of 50. Exclusion criteria for this group included prior total joint replacement and/or current recommendation for total joint replacement on the uninvolved extremity. Inclusion criteria for the control group included age

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above 50 and musculoskeletal pain of the back, hip, or knee. Patients were excluded for prior history of total joint replacement, back surgery of any kind, or current recommendation for total joint replacement. After agreeing to participate in the study, each patient was assigned a unique identifier to ensure patient confidentiality.

Procedures

Each patient was seen once for the purpose of this case control study. The following patient characteristics were gathered from intake forms: age, sex, body mass index (BMI), medical diagnosis, and involved lower extremity. A review of the patient's medical history was conducted to ensure no prior history of a total joint replacement or current recommendation for a total joint replacement for those with general musculoskeletal pain. Each patient characteristic was verbally confirmed by the patient during the interview. Institutional review board approval was not required for this study because all patients were seen during normal clinical visits and assessment of LLD was part of routine clinical care. Furthermore, since data were collected with unique identifiers, patient confidentiality was maintained for reporting purposes.

Measures

A visual pain scale (VPS) and the lower extremity functional scale (LEFS) were used to quantify pain intensity and functional level. The VPS is a measurement instrument that allows patients to describe their pain numerically. The VPS is a straight line with the left end, 0, representing "no pain at all" and right end, 10, representing the "worst pain imaginable." Patients were asked to rate their pain intensity level of the involved lower extremity that was "experienced on most days." The LEFS is used to evaluate the functional impairment of a patient with 1 or 2 involved lower extremities, with a score of 0 representing lowest functional level and a score of 80 representing highest functional level.

Active range of motion (AROM) of the patients' hips and knees were measured with a goniometer while the patient was supine. To measure AROM of the hip, the goniometer was centered over the greater trochanter of the femur. The stationary arm of the goniometer was aligned parallel to the lateral midline of the pelvis and the movement arm was aligned parallel to the lateral midline of the patient's femur, using the lateral epicondyle as a distal reference.

Table 1. Demographic Characteristics of Patients

	N	Mean	Standard Deviation	P-value
Age (y)				
Norms	20	69.5	10.6	0.565
THR*	20	66.9	10.5	
TKR*	20	66.4	8.1	
BMI*				
Norms	20	24.7	4.0	< 0.001
THR	20	27.9	6.0	
TKR	20	33.5	8.5	
VPS*				
Norms	20	4.7	2.2	0.034
THR	20	5.4	3.2	
TKR	20	6.9	2.4	
LEFS*				
Norms	20	46.5	12.2	< 0.001
THR	20	24.2	11.3	
TKR	20	29.1	8.8	
AROM* Hip Flex				
Norms	15	-0.7	5.8	0.160
THR	20	8.4	15.6	
TKR	20	5.4	15.6	
AROM Hip Ext				
Norms	15	1.7	4.8	0.102
THR	20	4.5	6.1	
TKR	20	0.8	5.4	
AROM Knee Flex				
Norms	15	-2.3	3.4	0.111
THR	20	2.0	13.6	
TKR	20	7.4	17.4	
AROM Knee Ext				
Norms	15	0.0	0.0	0.100
THR	20	-0.1	0.2	
TKR	20	1.0	2.6	

* Total Hip Replacement (THR); Total Knee Replacement (TKR); Body Mass Index (BMI); Visual Pain Scale (VPS); Lower Extremity Functional Scale (LEFS); Active Range of Motion (AROM)

Table 2. Clinical Characteristics of Patients and Clinical Relevance of True and Apparent Leg Length Discrepancy

	N	Mean	Standard Deviation	p-value	% Clinically Relevant	Chi-Square Asymp. Sig. (2-sided)
True LLD*						
Norms	15	-0.1	0.6		10%	.076
THR*	20	0.1	1.3	.167	40%	
TKR*	20	0.5	0.9		50%	
Apparent LLD						
Norms	15	-0.1	0.4		0%	.020
THR	20	1.0	2.3	.107	53.3%	
TKR	20	0.2	0.8		46.7%	

* Leg Length Discrepancy (LLD); Total Hip Replacement (THR); Total Knee Replacement (TKR)

In measuring hip flexion, patients were asked to bend their hip as far as possible before experiencing pain. In measuring hip extension, the patients were asked to extend their leg off the side of the bed as far as possible before experiencing pain. To measure AROM of the knee, the goniometer was centered over the lateral femoral epicondyle. The stationary arm of the goniometer was aligned parallel to the lateral midline of the femur, using the greater trochanter for proximal reference. The movement arm was aligned parallel to the lateral midline of the fibula, using the lateral malleolus and fibular head for distal reference. In measuring knee extension, a small towel roll was placed under the patient's ankle and patients were asked to straighten their knee as much as possible before experiencing pain. To measure knee flexion, patients were asked to bend their knee (keeping their foot on the bed) as much as possible before experiencing pain. This measure was used as a way to determine if there were soft tissue contractures influencing apparent leg length.

True leg length and apparent leg length were measured bilaterally. Using a tape measure, true leg length was measured from the anterior superior iliac spine to the medial malleolus, while apparent leg length was measured from the umbilicus to the medial malleolus. Leg length measurements obtained by use of a tape measure have been shown to be valid (r = 0.683) alone and improved validity was observed (r = 0.793) with the combined use of radiography.[6] True and apparent LLD was calculated by subtracting the uninvolved from the involved leg length for all patients and clinically relevant LLD was defined as LLD ≥ 10mm for the purposes of this paper.[3,5]

Data Analysis

Descriptive statistics were generated for the sample and visually inspected for outliers. We hypothesized that patients scheduled for THR would have the largest LLD and this hypothesis was investigated with a univariate ANOVA with LLD as the dependent variable and patient group as the independent variable. Post-hoc testing was performed for all ANOVA models with least square differences, as appropriate. This hypothesis was also investigated by chi-square analysis to compare the frequency of clinically relevant LLD (10 mm or greater) for each patient category.

Two exploratory analyses were then performed to further investigate LLD. First, the association of LLD to pain intensity, lower extremity function, hip ROM, knee ROM, and BMI was reported by Pearson correlation. Second, mean differences in pain intensity, lower extremity function, hip ROM, knee ROM, and BMI were investigated by comparing clinically relevant LLD to those without clinically relevant LLD. All analyses were performed with SPSS, version 15.0 using a type I error rate of .05.

Results

Demographic and clinical characteristics of this sample are summarized in Tables 1 and 2 respectively. ANOVA models indicated that differences were likely between the 3 groups for pain intensity ($p = 0.034$), LEFS ($p < 0.001$), and BMI ($p < 0.001$). Post hoc testing revealed that the only difference in pain intensity ratings was higher pain intensity for the TKR group in comparison to controls (95% confidence interval (CI) of difference = .5 – 3.9). Lower LEFS scores were observed for the THR group in comparison to controls (95% CI of difference = 15.4 – 29.2) and for the TKR group in comparison to the controls (95% CI of difference = 10.6 – 24.3). Post hoc testing also revealed that the TKR group had higher BMI scores in comparison to the controls (95% CI of difference = 4.7 – 12.9) and THR group (95% CI of difference = 1.6 – 9.7). There were no significant differences between the 3 groups for age, hip AROM, or knee AROM.

There were no significant differences in the mean for true or apparent LLD between the 3 groups (Table 2). Chi-square analysis revealed there were likely differences in frequencies of clinically relevant LLD across the 3 groups when measuring true LLD ($p = .076$) and apparent LLD ($p = .020$). When all 3 groups were combined for the exploratory analysis, there was a moderate association between true LLD and LEFS ($r = -.297$, $p = .028$), but not for apparent LLD (Table 3). Pain, ROM, or BMI were not correlated with either LLD measure (Table 3). When comparing group differences between clinically relevant and not clinically relevant LLD, those with a clinically relevant LLD were more likely to have higher pain and lower LEFS scores (Table 4A & B).

DISCUSSION

The purpose of this case control study was to determine whether patients scheduled for a total hip or knee replacement (TKR) had a larger LLD in comparison to age matched patients seeking physical therapy treatment for musculoskeletal pain. It was hypothesized that patients scheduled for a THR will have a larger LLD than both the control group and patients scheduled for a TKR. Previous research has compared

Table 3. Correlations between Leg Length Discrepancy and Patient Demographic Characteristics

	Pain	LEFS*	BMI*	AROM* Hip Flex	AROM Hip Ext	AROM Knee Flex	AROM Knee Ext
True LLD*							
Pearson Correlation	.222	-.297**	.193	.124	.119	.131	.127
Sig. (2-tailed)	.103	.028	.157	.366	.386	.339	.357
N	55	55	55	55	55	55	55
Apparent LLD							
Pearson Correlation	.135	-.218	-.138	.087	.110	-.076	.089
Sig. (2-tailed)	.327	.110	.316	.529	.426	.581	.519
N	55	55	55	55	55	55	55

* Leg Length Discrepancy (LLD); Lower Extremity Functional Scale (LEFS); Body Mass Index (BMI); Active Range of Motion (AROM)

** Correlation is significant at the 0.05 level (2-tailed)

Table 4A. Group Differences between Clinically Relevant and Not Clinically Relevant True Leg Length Discrepancy

	True LLD* > 10mm	N	Mean	Standard Deviation	Sig. (2-tailed)
VPS*	Not CR* CR	35 20	5.0 6.8	2.9 2.5	.024
LEFS*	Not CR CR	35 20	36.6 25.4	14.8 10.0	.004
BMI*	Not CR CR	35 20	27.5 31.2	6.7 8.3	.082
AROM* Hip Flex	Not CR CR	35 20	3.5 7.2	13.4 14.8	.353
AROM Hip Ext	Not CR CR	35 20	2.7 2.0	6.3 4.4	.661
AROM Knee Flex	Not CR CR	35 20	1.7 4.7	16.2 8.1	.436
AROM Knee Ext	Not CR CR	35 20	0.4 0.3	2.0 0.9	.794
True LLD	Not CR CR	35 20	-0.4 1.2	0.8 0.3	< 0.001
Apparent LLD	Not CR CR	35 20	0.4 0.4	1.9 0.6	.974

* Leg Length Discrepancy (LLD); Visual Pain Scale (VPS); Clinically Relevant (CR); Lower Extremity Functional Scale (LEFS); Body Mass Index (BMI); Active Range of Motion (AROM)

Table 4B. Group Differences between Clinically Relevant and Not Clinically Relevant Apparent Leg Length Discrepancy

	Apparent LLD* > 10mm	N	Mean	Standard Deviation	Sig. (2-tailed)
VPS*	Not CR* CR	40 15	5.2 6.9	2.9 2.2	.054
LEFS*	Not CR CR	40 15	35.0 26.1	15.1 9.0	.038
BMI*	Not CR CR	40 15	28.4 30.0	6.8 9.1	.509
AROM* Hip Flex	Not CR CR	40 15	4.7 5.2	13.1 16.5	.902
AROM Hip Ext	Not CR CR	40 15	2.2 3.0	6.1 4.5	.635
AROM Knee Flex	Not CR CR	40 15	2.3 4.0	15.1 9.9	.688
AROM Knee Ext	Not CR CR	40 15	0.1 1.1	0.7 2.8	.039
True LLD	Not CR CR	40 15	0.1 0.3	0.8 1.4	.680
Apparent LLD	Not CR CR	40 15	-0.1 1.8	0.5 2.4	< 0.001

* Leg Length Discrepancy (LLD); Visual Pain Scale (VPS); Clinically Relevant (CR); Lower Extremity Functional Scale (LEFS); Body Mass Index (BMI); Active Range of Motion (AROM)

LLD pre- and post-total joint replacement and has suggested an association between OA and total joint replacement,[5] but little research has actually been conducted to link LLD to THR. Over 28 weeks, 60 patients (20 THR, 20 TKR, 20 controls) were seen once to gather demographic characteristics and obtain outcome measures. This study revealed there to be no significant mean differences in true and apparent LLD across the 3 groups. When the clinically relevant LLD was defined as ≥ 10mm, there was a higher frequency of patients within the THR and TKR groups with clinically relevant LLD compared to those patients without clinically relevant LLD. Therefore, our original hypothesis was partially supported as this study shows there to be a potential association between clinically relevant LLD and preoperative total joint replacements.

Our results suggested that those with clinically relevant LLD had higher pain ratings and lower self-report of lower-extremity function. These results are similar to those found by Wright et al.[7] They conducted a pilot study of individual complaints before total hip replacements and found the most significant complaints to be day pain ($p = 0.04$) and difficulty with lower-extremity function ($p = 0.02$). Pain and decreased lower-extremity function are 2 deficits that are commonly treated in physical therapy. Range of motion deficits, however, were not associated with LLD, pain, or function, despite range of motion being a common treatment parameter for this patient population. Given the association with LLD, pain, and function, it is plausible that correcting LLD early on and treating associated deficits could potentially reduce pain, improve function, and delay the need for total joint replacements.

One limitation to this study was that the therapist was not blinded to the group status, so bias could have occurred with the LLD measurements. Another limitation was the ability to accurately measure true leg length in the obese patients, which was an issue in this sample as per the BMI data. Studies have shown that using the radiographic method of measuring LLD is more reliable than using the tape measure method.[3] Future studies should therefore examine the association between LLD and preoperative total joint replacements using the radiographic method as opposed to the tape measure method. Further research is also needed to support our contention that early treatment of LLD

could be a preventative measure for a total joint replacement. Knutson et al[3] found the most common effect of anatomic LLD to be the rotation of the pelvis and/or innominate bones. Mechanically, the weight of the body on the pelvis induces a force vector through both hip joints and towards the feet when standing. With a LLD, the pelvis, being pushed down on the femoral heads, must rotate anteriorly on the side of the lengthened lower extremity and posteriorly on the shortened side, causing added stress on both hip joints.[3] The result of this compensation could induce increased degeneration of the hip joints. This is of great concern given that studies have found that pelvic obliquity was the most common method of compensating for LLD up to 22mm.[3]

To specifically address this question, a future study is proposed recruiting patients, between the ages of 25 and 45, with a LLD and pelvic obliquity. This study would compare different methods of treating LLD and would look at the long-term effect of successfully treating LLD. Patients would be randomly placed in 1 of 3 groups: a control group receiving sham treatment, a group being treated for the LLD with a shoe lift, or a group being treated for pelvic obliquity (subsequently treating LLD) with muscle energy techniques. Patients would be treated for 8 weeks with their LLD being measured day 1 and at the end of the 8-week treatment with a radiograph. Other outcome measures would include the VPS and the LEFS. Patients would follow-up at 6 months and 1 year to determine the long-term effect of the treatment and then follow-up would occur every 5 years to determine if these patients would have a future need for a total joint replacement.

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Changes in Psychosocial Factors and Function in a Patient with Bilateral Knee Osteoarthritis: A Case Study

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ABSTRACT

Introduction: Research indicates psychosocial factors such as catastrophic thinking associated with pain, self-efficacy, and fear of movement/reinjury should be considered when treating patients with chronic conditions. The purpose of this case study is to report biweekly changes in clinical tests, psychosocial questionnaires, and subjective reports of function in a patient with bilateral knee osteoarthritis (OA).

Case Description: A 61-year-old female presented with a diagnosis of bilateral knee OA that impaired her ability to perform independent activities of daily living. Clinical tests (range of motion, strength, and pain), psychosocial questionnaires [Tampa Scale of Kinesiophobia-11 [TSK-11]), Pain Catastrophizing Scale (PCS), Knee Activity Self-Efficacy Scale (KASES), and Modified Self-Efficacy for Rehabilitation Outcome (MSER)], and subjective reports of function [International Knee Documentation Committee (IKDC) Subjective Form] were administered at initial evaluation, 2 weeks, 4 weeks, and discharge (6 weeks). Initial scores on psychosocial questionnaires and subjective reports of function indicated moderate levels of fear of movement/reinjury and self-efficacy for rehabilitation exercises, low levels of catastrophic thinking associated with pain and self-efficacy for physical performance, and substantial functional disability. The patient was seen for a total of 12 physical therapy visits over a 6-week period. Interventions addressed impaired muscle strength, decreased range of motion (ROM), and pain.

Outcomes: Clinically meaningful improvements were observed in the subjective reports of function and psychosocial questionnaires in the absence of meaningful improvements in knee ROM, knee strength, or pain.

Discussion: The patient's subjective reports of function improved dramatically while the results of clinical tests remained virtually unchanged. Psychosocial factors appear to contribute to this patient's improvement in subjective reports of function. Further research should investigate how change in psychosocial factors predicts change in subjective reports of function.

Key Words: *rehabilitation, kinesiophobia, self-efficacy, pain catastrophizing*

INTRODUCTION

As the population of elders in the United States continues to grow, osteoarthritis (OA) rapidly is becoming a diagnosis routinely seen in outpatient physical therapy clinics. Osteoarthritis is a chronic condition that most often affects the body's weight-bearing joints, especially the knee.[1] Currently, epidemiological reports indicate the incidence of OA is greater in females than males in all age groups, with 12.6% of females and 8.9% of males affected in the entire population.[2,3] Diagnosis of new cases of OA in females is greatest between 50 and 59 years of age with prevalence increasing linearly with age.[2,3] In females aged 60 or older, 42.1% have radiographic changes and 13.6% are symptomatic.[4] From a physical therapy standpoint, OA often is a difficult and frustrating disease to treat because it is progressive and degenerative. Patients typically do not retain long term effects of exercise therapy and ultimately receive a total knee arthroplasty to improve function and decrease pain.[5,6] Difficulty with rehabilitation is further confounded when the patient has bilateral knee OA.

Current literature focuses on the effectiveness of exercise therapy for this population.[5,7-9] Knee pain, strength, and range of motion (ROM) are clinical tests for patients with OA that are assessed when interpreting the effectiveness of the interventions.[5,7-9] However, there is mixed results of the effectiveness of exercise therapy on functional improvements and subjective reports of pain on short- and long-term outcomes in this population.[5,7-9] This may be because improvement in physical impairments may not capture true functional change.

A recent trend in research is to incorporate subjective reports of function and psychosocial questionnaires to assess the psychological affects of OA on the patient. These are then used as a complement to traditional measures of imaging reports and various other measures found in the physical examination.[10,11] Subjective reports of function are patient reported assessments of symptoms and function; whereas, psychosocial measures place emphasis on the interaction of psychological and environmental factors. Psychosocial factors, such as self-efficacy and pain related fear of movement/reinjury, have demonstrated a correlation with decreased functional outcomes and contribute to increased disability in the OA population.[11-13] Maly[11] found 45% of the variance in the Six Minute Walk Test, Timed Up and Go, and the stair climbing task were explained by self-efficacy scores and Heuts[12] found that pain related fear of movement and pain intensity accounted for about 40% of the variance in the level of functional impairment. Psychosocial issues are clinically important because certain people with OA do not improve in physical status with traditional physical therapy approaches.[11]

Current research focuses on the use of one psychosocial variable and its affect on subjective reports of function in chronic conditions. To the author's knowledge, no studies have examined the interactions of multiple psychosocial factors and their relation to subjective reports of function. The purpose of this case study is to report biweekly changes in clinical tests, psychosocial questionnaires, and subjective reports of function in a patient with bilateral knee OA.

CASE DESCRIPTION

History

The patient, a 61-year-old female, was referred to physical therapy for treatment of bilateral knee osteoarthritis. Her main complaint was a sharp, achy pain that was constant and worse in the left knee, and

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intermittent in nature in her right knee. The patient stated she underwent complete meniscectomy in her left knee 20 years ago and partial meniscectomy in her right knee several years ago. The patient further stated she had moderate pain in her knees and a locking sensation in her right knee prior to her surgeries. However, the pain in her knees never fully subsided and had become progressively worse over time. At the time of the evaluation, the patient reported her left knee was clicking and popping, and she was unable to bend her knee completely or walk long distances without pain. Furthermore, the patient stated she used a straight cane when her pain increased. Walking for 20 minutes or standing in place increased her pain; however, 600 mg of ibuprofen and lying with her legs extended decreased her pain. The patient's history was unremarkable. X-rays were previously obtained; however, the results were unknown and unavailable at the time of the physical therapy evaluation. The patient indicated that she wanted to perform physical therapy to achieve her overall goal of not undergoing total knee arthroplasties.

EXAMINATION

The patient presented to the physical therapy clinic ambulating independently without an assistive device. Palpation of bilateral knees revealed tenderness to the bilateral pes anserinus, medial femoral condyles, and medial gastrocnemius heads, left lateral gastrocnemius head, infrapatellar fat pad, and medial patellar facet. Circumferential measurements were obtained using a standard metric tape measure with the mid-patella as the reference point, and distances of 10 cm and 5 cm distal to the mid-patella and 15 cm proximal to the mid-patella were measured. The measurement points were marked on the skin using an ink pen. Circumferential measures are as follows: 10 cm distal to the mid-patella – left 46 cm, right 44.5 cm; 5 cm distal to the mid-patella – left 48 cm, right 45 cm; mid-patella – left 51 cm, right 49 cm; 15 cm proximal to mid-patella – left 61.5 cm, right 61 cm. The patient exhibited moderate effusion in the left knee compared to the right knee. Range of motion measurements were obtained using a goniometer and standard goniometric techniques, and were assessed to be as follows: active/passive ROM knee flexion (left: 105/110°; right: 110/110°) and extension (left: 15/10°; right: 5/0°). Manual muscle tests (MMT) of the bilateral lower extremities were obtained using standard muscle testing positioning and techniques. Muscle testing revealed weakness of the following musculature: bilateral hip abductors (4/5), hip flexors (left 4-/5, right 3+/5), knee extensors (left 4/5 with pain, right 4-/5), and right knee flexors (3+/5). Pain was elicited in the right knee during these measurements. Hamstring flexibility bilaterally was also grossly limited.

Patient reported pain was obtained using a verbal numeric rating scale (VNRS). The patient was asked to rate her pain from 0 to 10 (0 = no pain and 10 = worst pain imaginable). The VNRS correlates well with the visual analog scale, and has been shown to be a reliable and valid measure of pain intensity in patients with chronic pain.[14-16] The patient reported that her worst pain was 8/10 and at the time of the evaluation was 3/10, which is its best.

After the physical examination, the patient completed the International Knee Documentation Committee (IKDC) Subjective Form, Tampa Scale for Kinesiophobia-11 (TSK-11), Knee Activity Self-Efficacy Scale (KASES), Modified Self-Efficacy for Rehabilitation Outcome (MSER), and Pain Catastrophizing Scale (PCS).

The IKDC Subjective Form is a reliable, responsive, and valid outcome measure based on subjective reports of symptoms and function due to impairments of the knee.[17,18] It has been shown to have high construct validity (coefficient alpha = 0.92) and high levels of test-retest reliability (0.94).[18] The IKDC Subjective Form was designed as an evaluative measure to detect improvement or deterioration in symptoms, function, and sports activity experienced by patients with a variety of knee conditions including: ligament and meniscal injuries; articular lesions, such as OA; and patellofemoral pain.[18] It consists of 18 items designed to measure subjective reports of pain, stiffness, swelling, joint locking, joint instability, and the ability to perform activities of daily living.[19] Low scores indicate increased reports of symptoms and disability. The patient scored a 21.84 at the initial evaluation which placed her in the 5th percentile of her age and gender matched cohort.

The Tampa Scale for Kinesiophobia is a 17-item measure that assesses the fear of movement or reinjury that was originally developed for the chronic low back pain population.[20] The TSK has been validated in the knee OA population and was shown to be a significant predictor of daily functioning in these patients.[12] The TSK-11 is a shortened version of the original TSK that possesses similar psychometric properties to the original and offers the advantage of brevity.[20] It possesses good internal consistency (coefficient alpha = 0.79), test-retest reliability (ICC=0.81), and is responsive (SRM = -1.11).[20] Total scores range from 11 to 44 with higher scores reflecting greater fear of movement/reinjury.[20] Standardized cut-off indicating levels of fear of movement/reinjury have yet to be validated. The patient's score at the initial evaluation of 29 out of 44 indicated she possessed moderate levels of fear of movement/reinjury, based on a score of 22 as half of the maximum score.

The KASES was modified from the Knee Self Efficacy Scale originally introduced by Thomee et al.[21] The Knee Self Efficacy Scale identifies how patients perceive their physical performance or function and future physical performance or prognosis of their knee.[21] The KASES consists of 10 questions that ask the patient to rate their confidence level when performing physical activities. Examples of questions include, "I can perform a full squat," "I can walk normally on all types of surfaces (eg, stairs, ice, uneven ground)," and "I can participate in physical activity even if I have knee symptoms (eg, pain or swelling)." Scores are rated on an 11-point Likert scale (0=strongly disagree and 10=strongly agree) with a maximum score of 100. Higher scores indicate higher levels of self-efficacy during physical activity. The patient's score of 11 out of 100 at the initial evaluation indicated low levels of self-efficacy during physical activity, based on a score of 50 as half of the maximum score.

The MSER was modified from the Self-Efficacy for Rehabilitation Outcome Scale (SER) introduced by Waldrop et al.[22] The SER assess patients' belief about their ability to perform activities typical of physical rehabilitation.[22] The MSER consists of 10 questions that ask patients to rate their confidence level in performing activities related to rehabilitation. Examples of questions include, "I believe I can do therapy that requires me to stretch my leg," "I believe I can do all of my exercises during rehabilitation," and "I believe I can do my therapy no matter how tired I may feel." Scores are rated on an 11-point Likert scale (0=I cannot do it and 10=certain I

can do it) with a maximum score of 100. Higher scores indicate higher levels of self-efficacy for performing activities typical of rehabilitation. The patient's score of 67 out of 100 indicate moderate levels of self-efficacy for performing activities typical of rehabilitation, based on a score of 50 as half of the maximum.

The PCS is a 13 question self-report measure of catastrophic thinking associated with pain and has been suggested to be a useful tool in identifying individuals who may be susceptible to catastrophic thinking associated with pain.[23,24] It possesses good reliability (Coefficient alpha=0.87) and good stability over time (r = 0.75).[23] Total scores range from 0 to 52 with higher scores indicating higher levels of catastrophic thinking associated with pain. The patient's score of 12 indicates she possesses a low level of catastrophic thinking associated with pain (50th percentile cut off score=20).[24]

EVALUATION

Diagnosis

Based on the findings from the subjective history and examination, the patient exhibited signs, symptoms, and impairments related to bilateral knee osteoarthritis. According to the patient's responses from the IKDC subjective form, the patient is only able to tolerate light activities, such as walking, housework, or yard work, without significant knee pain, swelling, and giving way in the knees. Furthermore, the patient is limited in independent activities of daily living due to these impairments.

Prognosis

The patient was a motivated individual who set a personal goal of avoiding total knee arthroplasties. Based on impairments, functional limitation, patient motivation, and physician recommendation, the patient was given a frequency of treatment twice per week for 6 weeks. According to the *Guide to Physical Therapist Practice*, the patient will demonstrate optimal joint mobility, motor function, muscle performance, and ROM and the highest level of functioning in home, work, community, and leisure environments over the next 2 to 4 months.[26]

Intervention

Research suggests that quadriceps muscle strength and pain severity are important determinants of disability in patients with knee OA.[26,27] There is strong evidence suggesting that lower extremity strengthening and land based exercises have significant positive effects on pain and physical functioning.[5,8,28] Literature currently recommends progressive muscle strengthening, stretching of tight muscles, and maintaining existing ROM of the joints for the treatment of OA.[28,29] Therefore, interventions were targeted to address hip and knee strength and ROM, along with pain modulation and inflammation control, to achieve the overall goals of improving lower extremity strength and performance of independent activities of daily living pain free.

The patient completed a total of 12 physical therapy visits over a 6-week period. Plinth exercises were initially implemented with progression to weight bearing exercises as tolerated. Treatment began immediately after the initial evaluation was completed. Moist heat packs were placed on her bilateral knees for 10 minutes prior to activities. The patient was then instructed and performed bilateral seated hamstring and gastrocnemius stretches. Hamstring stretches were performed seated on the plinth with one leg fully extended while the contralateral leg was allowed to hang off the side of the plinth for comfort. The patient was instructed to keep her back and knee straight and to reach for her toes while maintaining this position. Gastrocnemius stretches were performed seated in the same position as the hamstring stretch but with a gait belt around the foot of the extended leg. The patient was instructed to keep her knee straight and pull back on the gait belt until she felt a comfortable pull in the back of her lower leg.

The patient held each stretch for 10 seconds to tolerance, a total of 5 times. Quadriceps sets, heel slides, and resistance band hip abduction with a red resistance band were performed 2 sets of 10 repetitions. Straight leg raises were also implemented and were performed with 1 set of 10 repetitions. Each exercise was performed bilaterally. A cold pack was applied to each knee post exercise for 10 minutes. The patient was given a home exercise plan consisting of the exercises performed that day and was instructed to perform the exercise 2 times per day to maximize out of therapy time. The patient was also instructed to use either a cold pack or ice at home as needed for symptoms.

At visit 2, the patient reported she was walking with less clicking and popping in her left knee, and was able to walk with less of a limp. Seated adductor ball squeezes and standing heel/toe raises were added to progress her program. Wall slides were attempted; however, the patient was unable to complete these without pain in her knees, and therefore they were removed. The patient was able to complete all remaining exercises in her program without symptom provocation.

During visit 3, the patient indicated pain and swelling had increased, and further stated that she may have overexerted herself in doing her home exercise program that weekend. She also indicated that the standing heel/toe raises bothered her knees, and equated the increase in symptoms to that exercise. Therefore, the standing heel/toe raises were changed to seated ankle plantarflexion exercises with a red resistance band.

At visit 4, the patient indicated her right knee had been bothering her since the last visit. The patient stated that the exercises that required her to fully extend and fully flex her knee bothered her. Therefore, the quadriceps sets and hamstring stretches were modified to decrease forced knee extension. The patient was given a small, soft bolster to place under each knee to provide slight knee flexion while performing the offending exercises. Heel slides emphasizing improved knee flexion were discontinued. These modifications to specific exercises and overall exercise program lead to decreased complaints of pain and discomfort.

At visit 5, two weeks after beginning physical therapy, the patient subjectively indicated that she was able to walk around an art show and grocery shop without an increase in symptoms. Minimal swelling in the right knee was noted with decreased swelling in the left knee.

On visit 6, recumbent cycling was implemented into the exercise program. The patient was instructed to pedal at a comfortable pace for 5 minutes avoiding undue pain in her knees. The patient was able to complete cycling with minimal symptoms. However, at the next visit, she stated that her left knee and ankle had become swollen over the weekend, and the clicking in her knee had increased. In response, the recumbent cycling was discontinued. The interventions remained unchanged until patient discharge; however, repetitions and sets were increased for strength and muscular endurance progression.

Improvements in scores for the psychosocial questionnaires, subjective reports of function, and pain were used as a surrogate for patient improvement in exercises. Once progression to weight bearing exercises stopped on visit 7, the patient ceased to report any increase in pain or swelling. The patient reported she was able to begin working in the yard, walking around church and other social events, and sit for longer periods of time.

Outcomes

Clinical tests, subjective report of function, and psychosocial questionnaires were evaluated at the initial evaluation (IE), 2 weeks, 4 weeks, and at discharge (6 weeks). Bilateral knee flexion and extension strength, subjective reports of pain, and bilateral knee ROM were the clinically important tests assessed for outcomes. The patient's scores on the subjective report of function and psychosocial questionnaires for all time points can be seen on Table 1. Assessments of clinical tests at all time points can be seen on Table 2.

Strength in the right knee flexors improved the most from IE to week 2 with strength assessed to be 3+/5 and 5/5 respectively. At week 2, right knee extensors and left knee flexors strength was 5/5. At discharge, bilateral knee extensors and right knee flexors strength was 5/5. Pain intensity decreased to 0/10 at week 2, where it remained constant until discharge. Range of motion was virtually unchanged from IE to discharge. Final active ROM measurements were 5/110° of right knee motion and 10/100° of left knee motion.

Minimally detectable change (MDC) for the IKDC is ±12.8 points.[17] Meaningful improvements on the IKDC occurred from IE to week 2 and week 2 to week 4. An overall improvement of 34.48 points indicates there was a significant enough change that the patient would perceive an improvement in symptoms and function. According to Irrgang,[17] change scores greater than 20.5 points would effectively rule in the individual perceiving him or herself to be improved. This corresponds to patient reported improvements in independent activities of daily living and community ambulation.

An improvement of 4 points on the TSK-11 maximizes the likelihood that a patient has reduced their fear of movement/reinjury.[20] Meaningful improvements were seen from IE to week 2 and week 2 to week 6, with an overall improvement of 15 points from IE to discharge.

The patient's overall PCS score improved 12 points from IE to discharge. Based on the reliability study performed by Sullivan,[23] we can be 95% confident that a score change of 11.8 points in females indicates true change on the PCS. At discharge, the patient scored 0 on the PCS, which would indicate she no longer possessed distressful feelings when she was in pain.

Given that the MSER and KASES were modified from the original versions, MDC or standard error of the measure are not available. However, based on a total possible score of 100 points, it can be inferred that a 25 point change on the KASES would indicate a moderate improvement in self efficacy in physical performance and prognosis. At the IE, the patient scored 7 out of 10 questions a 0 (strongly disagree) and 0 out of 10 questions a 10 (strongly agree); however, at discharge the patient the patient only scored herself a 0 on 4 questions ("I can perform a full squat;" "I can hop on the injured leg;" " I can run straight ahead;" and "I can make sudden changes in direction while running") and 3 questions increased to a 10 ("I can return to the same physical activity level as before the injury;" "I can avoid new injuries to my knee;" and "My knee will not be worse than before surgery"). It can also be inferred that a 28 point improvement from IE to discharge, and a score of 95 at discharge would indicate large improvement in self efficacy for performing activities typical of rehabilitation. At the IE, the patient did not respond to any questions with a 10 (certain I can do it) with a majority of the answers reported as a 5 (4 questions) or 8 (5 questions); however, at discharge the patient scored 7 questions a 10, two questions a 9, and one question a 7.

DISCUSSION

The purpose of this case study is to report biweekly changes in clinical tests, psychosocial questionnaires, and subjective reports of function in a patient with bilateral knee OA. The patient in this case exhibited improvements in all psychosocial variables and subjective reports of function at all time points without clinically

Table 1. Outcome Measures Scores

	IKDC	TSK-11	PCS	KASES	MSER
Initial Evaluation	21.84 (5TH)	29	12	11	67
2 weeks	35.63 (15TH) *	21*	2	48	92
4 weeks	51.72 (25TH) *	19	1	44	88
6 weeks	56.32 (30TH) **	14*	0 †	36	95

* indicates significant minimally detectable change compared to the previous administration
** indicates a high likelihood that the patient would perceive her condition to be improved
† 95% confidence of true change from initial evaluation

Table 2. Clinical Tests Results

	Right Knee ROM: extension/flexion	Left Knee ROM: extension/flexion	Right Knee MMT: extension	Right Knee MMT: flexion	Left Knee MMT: extension	Left Knee MMT: flexion	Pain
Initial Evaluation	5/110	15/105	4-/5	3-/5	4/5	5/5	3/10
2 weeks	5/110	15/105	5/5	5/5	4/5	5/5	0/10
4 weeks	5/110	15/110	5/5	5/5	5/5	4/5	0/10
6 weeks	5/110	10/100	5/5	5/5	5/5	4/5	0/10

Table 3. Pain, Swelling/Stiffness and Self-efficacy

	IKDC #3	IKDC #4	KASES #9
Initial Evaluation	4	1	0
2 weeks	7	2	10
4 weeks	9	3	8
6 weeks	10	4	2 *

IKDC question #3 is a rating of pain intensity with 10 indicating no pain and 0 indicating worst pain imaginable.

IKDC question #4 is a rating of knee stiffness or swelling; 0=extremely, 1=very, 2=moderately, 3=mildly, or 4=not at all.

KASES question #9, is rating of how confident the patient is participating in physical activities even if knee symptoms (eg, pain or swelling) are present; 0=strongly disagree to 10=strongly agree.

* Score of 2 points at 6 weeks indicates patient's acceptance of limitations

meaningful changes in ROM, strength, or pain. Psychosocial variables have been identified previously as important indicators of outcomes in patients with chronic conditions;[11-13] however, current research is void of any reports pertaining to the use of multiple psychosocial questionnaires during the treatment of chronic conditions. Furthermore, there is no known evidence reported on the relationship of self-efficacy, fear of movement/reinjury, and pain catastrophizing with subjective reports of function. Improvements in subjective reports of function appeared to be related to a clinically meaningful increase in self-efficacy and decreases in fear of movement/reinjury and catastrophic thinking associated with pain.

Results of clinical tests remained virtually unchanged throughout the course of physical therapy. The greatest improvement of all the clinical tests was seen in right knee flexors strength, with an increase from 3+/5 to 5/5 in 2 weeks. However, the author does not believe this is a true indication of muscle strength gain in terms of hypertrophy, rather a reflection of improvements in psychosocial variables and decreased pain within the first 2 weeks of physical therapy that allowed for greater expression of strength. Improvements on all of the psychosocial questionnaires were the greatest from IE to week 2 as seen on Table 1. During the IE, the patient subjectively reported knowing muscle testing would cause her knee to hurt. Muscle testing of the right knee flexors was painful to her, and it was undetermined if maximum effort was obtained. However, 2 weeks later, the patient's pain had improved to 0/10 and all psychosocial questionnaires were considerably improved resulting in a muscle grade of full strength (5/5). This could indicate a possible interaction between self-efficacy, fear of movement/reinjury, and catastrophic thinking associated with pain at the initiation of physical therapy.

Progression of exercises from nonweight bearing, light resistance exercises to weight bearing, heavy resistance exercises was attempted on multiple visits without success due to patient reported pain and swelling in her knees. These symptoms were exacerbated when weight bearing exercises or activities that required repetitive movements were added. However, the patient's reports did not correlate with IKDC scoring on question 3, "If you have pain, how severe is it?" and question 4, "During the past 4 weeks, or since your injury, how stiff or swollen was your knee?" or question 9 on the KASES, "I can participate in physical activity even if I have knee symptoms (eg, pain or swelling)" as seen in Table 3. The patient progressively noted improvements on questions 3 and 4 of the IKDC and a substantial improvement on question 9 of the KASES at 2 weeks, with decreased scores at the end of physical therapy. This parallels the results of Maly et al[13] that indicated the importance of stiffness in determining the degree of self efficacy in individuals with knee OA in performing physical tasks. They suggested that joint stiffness provides negative feedback to individuals with knee OA during physical activity and therefore influences self efficacy.[13] In an earlier study, Maly[11] also indicated the importance of self-efficacy in relation to function and suggested the more certain people were that they could complete physical tasks, the better they would performed them.[11]

Only light resistance, as determined by absolute load, was used for strengthening exercises for patient tolerance. Knee strength has been identified multiple times as a key indicator of physical performance and disability in older patients with knee OA,[11,13,27,30] and improvements in knee musculature strength is a goal in the treatment of this population. Jan et al[31] indicated that low resistance exercise training was as effective as high resistance exercise training in reducing pain and improving function in patients with knee OA. Strength improved in both groups; however, a larger training effect was observed in the high resistance group compared to the light resistance group.[31] Although the patient did not specifically make significant strength gains while performing her exercises, the improvements in strength she did make were likely the result of neuromuscular learning and neural adaptation resulting in the knee musculature stabilizing the knee joint.[31]

Future research should investigate longitudinally how change in psychosocial factors predicts change in subjective reports of function in patients diagnosed with knee OA. Examining multiple psychosocial factors in relation to subjective reports of function differs from current research where only one psychosocial variable is examined at a time. A secondary objective would be to investigate if the onset of physical therapy contributed to improvements of these psychosocial variables. The author proposes a descriptive study where patients referred to physical therapy for the treatment of knee OA are given the IKDC Subjective Form, TSK-11, PCS, KASES, and MSER. The subjects will be asked to fill each form biweekly from IE to discharge. Interventions will be not be standardized, and progression of the exercises will be as symptoms and pain allow. Researchers will investigate the scores of each questionnaire at IE, 2 weeks, and 4 weeks specifically to identify if there is an interaction between the initiation of physical therapy rehabilitation and improvement in patient reported fear of movement/reinjury, catastrophic thinking associated with pain, and self-efficacy. This study would highlight the importance of psychosocial variables in the OA population, and would help answer the question of why some patients with OA do not improve with exercises targeted at improving impairments.

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The Association of Fear of Movement/ Reinjury and Self-efficacy with Function in Patients after Knee Injury

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ABSTRACT

Background: Psychosocial factors are not routinely addressed during knee rehabilitation but may be important in achieving maximum functional gains. Individually, fear of movement/reinjury and self-efficacy have demonstrated associations with functional outcomes in knee injury populations.

Objective: The primary objective was to determine, in subjects after knee injury, the association of fear of movement/reinjury and self-efficacy with self-report of function at initiation of rehabilitation. The secondary objectives were to compare levels of these psychosocial factors between subgroups formed on the basis of mechanism of injury and surgical status, and to investigate the correlations between scores on fear of movement/reinjury and self-efficacy questionnaires.

Design: Cross-sectional.

Methods: Twenty-eight subjects with knee injury completed self report questionnaires for knee function (IKDC subjective form), fear of movement/reinjury (TSK-11) and self-efficacy (KA-SES, MSERO), and gave verbal pain intensity rating. A hierarchical linear regression model was conducted to determine factors predicting IKDC subjective form scores. Independent samples t-tests were conducted to determine differences in TSK-11, KA-SES, and MSERO between subgroups (traumatic/nontraumatic, surgical/nonsurgical).

Results: The regression model predicted 67% of the variance in self-report of function with the TSK-11 and KA-SES scores as unique contributors. The traumatic injury group had significantly higher TSK-11 scores. TSK-11 and KA-SES questionnaires demonstrated a moderate significant association.

Limitations: Limitations include decreased sample size from different knee diagnoses, and lack of validation for self-efficacy questionnaires.

Conclusions: Psychosocial factors appear to be important predictors of self-report of function in subjects with knee injury. Subjects with traumatic knee injury may have increased fear of movement/reinjury.

Key Words: *knee joint, fear of movement/reinjury, self-efficacy*

INTRODUCTION

Traditionally, physical therapy treatment for subjects after knee injury is focused on addressing physical impairments; however, recent evidence has demonstrated that psychosocial factors may have an impact on functional recovery.[1,2] Identifying specific psychosocial factors that impact function could be an important consideration because addressing those factors may enhance the effectiveness of the rehabilitation process. Among the psychosocial factors associated with decreased function during knee rehabilitation are increased fear of movement/reinjury and reduced self-efficacy.[3,4]

Vlaeyen and Linton[5] described the fear-avoidance model of pain, in which there are 2 types of behaviors in response to pain: confrontation and avoidance, the latter of which gives way to increased disuse and disability. Fear of movement/reinjury is an avoidance behavior that has been extensively studied in subjects with low-back pain and has been related to poor outcomes in rehabilitation.[6-8] This psychosocial factor also has been correlated with decreased self-report of function in populations after anterior cruciate ligament (ACL) reconstruction[3] and with knee osteoarthritis (OA).[9] In a study by Kvist et al,[3] subjects 3 to 4 years after ACL reconstruction surgery who did not return to their previous level of function had higher fear of movement/reinjury than those who were able to return. In a different patient population, Heuts et al[9] found higher fear of movement/reinjury was correlated with decreased self-report of function in subjects with knee or hip OA. The literature is limited in examination of fear of movement/reinjury as a unique contributor in the prediction of functional outcomes after accounting for demographic variables.[10] Additionally, no known studies have investigated the difference levels of fear of movement/reinjury in groups based on mechanism of injury or surgical status.

Self-efficacy was initially defined in Bandura's[11] social-cognitive theory as one's perception of his or her ability to successfully perform a task. Bandura proposed this perception of ability impacts actions through 4 processes: cognitive, motivational, affective, and decisional.[12] From a knee rehabilitation perspective, patients may have varying beliefs about their ability to perform functional tasks (ie, running, jumping) or participate in rehabilitation interventions (ie, stretching, therapeutic exercise) that ultimately could impact functional outcomes. Thomeé et al[4] found that higher self efficacy had a positive correlation with improved self-report of function and physical activity participation in subjects after ACL reconstruction surgery. Reporting similar findings, in subjects after total knee (TKA) and total hip arthroplasty (THA), van den Akker-Scheek et al[13] demonstrated a correlation between increased self-efficacy, and increased self-report of function and faster walking speeds.

No known studies have examined the association of fear of movement/reinjury and self-efficacy with self-report of function in the same knee injury population. Fear

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of movement/reinjury and self-efficacy describe 2 different psychosocial constructs, which may have different relationships with functional return during rehabilitation. Furthermore, the correlation between fear of movement/reinjury and self-efficacy in subjects after knee injury is unknown, which may be an important factor in determining methods to address these psychosocial factors. Higher fear of movement/reinjury or decreased self-efficacy may be present in populations with certain demographic characteristics, such as those based on mechanism of injury or surgical status. Identifying these demographics may also allow clinicians to determine those patients that are prone to these psychological factors. The primary objective of this study was to determine, in subjects after knee injury, the association of fear of movement/reinjury and self-efficacy with self-report of function at the initial physical therapy evaluation. The secondary objectives were to: (1) compare levels of these psychosocial factors between subgroups formed on the basis of mechanism of injury and surgical status, and (2) investigate the correlations between scores on fear of movement/reinjury and self-efficacy questionnaires. The authors hypothesized that psychosocial factors would be significant predictors of self-report of function in subjects after knee injury. In addition, the authors also hypothesized that levels of fear of movement/reinjury and self-efficacy would be significantly different in groups based on mechanism of injury or surgical status, and correlations would exist between scores on the psychosocial questionnaires as an increased fear of movement/reinjury would signify decreased self-efficacy.

MATERIALS AND METHODS

Subjects

Data were collected during two 8-week internships at different outpatient physical therapy clinics. Subjects were considered for study inclusion if their diagnosis included knee injury and the primary author was involved in their care or evaluation (Figure 1). Subjects were excluded from the study if they were unable to read or interpret the questionnaires, or if they failed to return questionnaires. Additionally, questionnaires with less than 90% completion were excluded from analysis. Because data collected was part of routine patient care, no Institutional Review Board approval was required for this study.

Data collection procedures

Demographic information on age, sex, mechanism of injury, and surgical status was obtained from the subjective portion of the physical therapy evaluation. Subjects completed self-report questionnaires, including the: (1) shortened Tampa Scale of Kinesophobia (TSK-11),[14] (2) International Knee Documentation Committee subjective form (IKDC),[15] (3) Knee Activity Self-Efficacy Scale (K-ASES), and (4) Modified Self-Efficacy Rehabilitation Outcome (MSERO) at the end of their initial treatment session. The subjects were asked to measure current pain intensity with a verbal numerical rating scale (VNRS) on an 11-point analog scale (0 = "no pain" and 10 = "worst pain imaginable"). Subjects who were not able to complete the questionnaire during the initial treatment session were asked to return the questionnaires at their next visit.

An average was calculated for any missing responses based on answers to the remaining questions. Only questionnaires with 90% of questions completed were considered for analysis, which was a criteria set for by Irrgang et al[15] for the IKDC subjective form. The authors chose to use the same criteria for the TSK-11, KA-SES, and MSERO.

Self-report questionnaires

The IKDC subjective form was developed to measure self-report of function and has been validated for use with knee impairments, including ligament injury, meniscal injury, OA, patellofemoral injury, fracture, and nonspecified joint pain.[16] The IKDC subjective form contains questions regarding pain, swelling, and episodes of giving way as well as ability to performtfunctional tasks. Scores on the IKDC subjective form range from 0 to 100, with a higher score indicating higher function. The IKDC subjective form has been found to be reliable, valid, and responsive for use with subjects after knee injury.[15,16]

The TSK-11 is a shortened version of the original 17-item TSK[17,18] and measures pain-related fear of movement/reinjury in musculoskeletal impairment. The TSK originally was used in the low-back pain population,[19] and has been used with knee patient populations, including OA[9] and post-ACL reconstruction surgery.[3] The TSK-11 eliminates 6 psychometrically poor items from the original questionnaire and scores range from 11 to 44 with an increase in score indicating an increase in fear of movement/reinjury.[14] Questions are scored on a 4-point Likert scale (0 = "Strongly agree" and 10 = "Strongly disagree") and are divided into 2 types: somatic focus and avoidance activities.[14] Sample questions from the TSK-11 include "Pain always means I have injured my body" and "No one should have to exercise when they are in pain." Woby et al[14] found the TSK-11 to have good internal consistency, test-retest reliability, responsiveness, concurrent validity, and predictive validity.

Two questionnaires were used to measure self-efficacy in everyday activity and rehabilitation: the Knee Activity Self-Efficacy Scale (KA-SES) and the Modified Self-Efficacy for Rehabilitation Outcome (MSERO). The KA-SES relates to the subject's perception of what everyday tasks he or she is able to accomplish while the MSERO focuses on rehabilitation tasks. The 10-item KA-SES was adapted from the

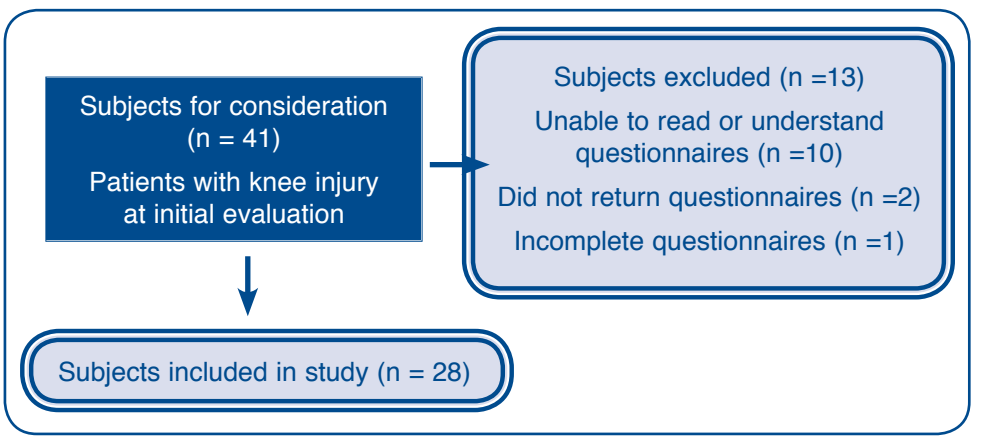

Figure 1. Inclusion protocol.

Knee Self-Efficacy Scale, which was shown to be valid and reliable in a population of subjects with ACL injury.[4,20] Answers are scored on an 11-point Likert scale (0 = "Strongly agree" and 0 = "Strongly disagree"). Scores range from 0 to 100 with a higher score on the KA-SES relating to a higher level of activity self-efficacy. A group of experienced clinicians and researchers at the University of Florida and Shands Rehab at the Orthopaedic and Sports Medicine Institute modified and abbreviated the outcome measure to include questions regarding more generalized activities believed to be better suited to the clinic's patient population (Table 1). For example, "walking in a forest" and "moving around in a rocking boat" were combined into "I can walk normally on all surfaces." The 10-item MSERO is modified from the Self-Efficacy for Rehabilitation Outcome Scale, which was shown to be valid and reliable in a population of subjects post THA or TKA.[13,21,22] The questions on the MSERO involve the subject's perception of his or her ability to complete rehabilitation tasks. Each question is scored on an 11-point Likert scale (0 = "I cannot do it" and 10 = "Certain I can do it"). Scores range from 0 to 100 with a higher score on the MSERO indicating a higher level of rehabilitation self-efficacy. The same group of clinicians and researchers removed 2 questions from the original Self-Efficacy for Rehabilitation Outcome Scale which were opined to be redundant (Table 1). "The exercises my therapists say I should do, even if I don't understand how it helps me" and "my therapy no matter how I feel emotionally" were eliminated to create the briefer questionnaire. The KA-SES and MSERO have not been previously reported in the literature.

Pain intensity was measured with an 11-point verbal numeric rating scale (VNRS), with 0 indicating "no pain" and 10 indicating "the worst pain imaginable." Comparable scales have demonstrated a validity and reliability in subjects with nontraumatic[23] and acute pain.[24]

Data management

Subjects were subdivided into categories based on the mechanism of injury (traumatic or nontraumatic) and surgical status (surgical or nonsurgical). Subjects were placed into the traumatic injury subgroup if they reported a single episode of injury, while gradual onset of pain over time was classified as nontraumatic. Subjects were considered surgical if they had undergone a surgical procedure during the current episode of care; otherwise, they were placed in the nonsurgical category.

Data analysis

Descriptive statistics were generated for demographic information and the IKDC subjective form, TSK-11, KA-SES, and MSERO questionnaires. Independent samples t-tests were conducted to determine difference in age and Chi-square tests were conducted to determined group differences

Table 1. Self-Efficacy Scales

Knee Activity Self-Efficacy Scale

(Questions are score from 0 to 10 with degrees ranging from "Strongly agree" to "Strongly disagree")

I am confident that…

1. I can perform a full squat
2. I can make a turning movement while standing
3. I can walk normally on all types of surfaces (e.g. stairs, ice, uneven ground)
4. I can hop on the injured leg
5. I can run straight ahead
6. I can make sudden changes in direction while running
7. I can return to the same physical activity level as before the injury
8. I can avoid new injuries to my knee
9. I can participate in physical activity even if I have knee symptoms (e.g. pain or swelling)
10. My knee will not be worse than before surgery

Knee Self-Efficacy Scale [20]

(In sections A, B and C, patients are instructed to answer based on current abilities. In section D, patients are instructed to answer based on future abilities. Questions are scored from 0 to 10 with degrees ranging from "not at all" to "very certain.")

A. Daily activities
How certain are you about?:

1. Walking in the forest
2. Climbing up and down a hill/stairs
3. Going out dancing
4. Jumping ashore from a boat
5. Running after small children
6. Running for tram/bus
7. Working in the garden

B. Sports and leisure activities
How certain are you about?:

1. Cycling a long distance
2. Cross country skiing
3. Riding a horse
4. Swimming
5. Hiking in the mountains

C. Physical activities
How certain are you about?:

1. Squattng
2. Jumping sideways from one leg to the other
3. Working out hard a short time after the injury or surgery
4. Doing one-leg hops on the injured leg
5. Moving around in a rocking small boat
6. Doing fast twisting

D. Your knee function in the future
How certain are you that?:

1. ¥ou can return to the same physical activity level as before the injury?
2. You would not suffer any new injuries to your knee?
3. Your knee will not "break"?
4. Your knee will not get worse than before the surgery? (for those of you who underwent surgery)

Modified Self-Efficacy for Rehabilitation Outcome

(Questions are score from 0 to 10 with degrees ranging from "I cannot do it" to "Certain I can do it")

During my rehabilitation, I believe I can do…

1. Therapy that requires me to stretch my leg
2. Therapy that requires me to lift my leg
3. Therapy that requires me to bend my knee
4. Therapy that requires me to stand
5. Therapy that requires me to walk
6. All my exercises during rehabilitation
7. My therapy every day that it is scheduled
8. My therapy no matter how tired I may feel
9. My therapy even though I may already have other complicating illnesses
10. My therapy regardless of the amount of pain I am feeling

Self-Efficacy for Rehabilitation Outcome Scale [22]

(Questions are score from 0 to 10 with degrees ranging from "I cannot do it" to "Certain I can do it")

During my rehabilitation, I believe I can do…

1. Therapy that requires me to stretch my leg
2. Therapy that requires me to lift my leg
3. Therapy that requires me to bend my leg
4. Therapy that requires me to stand
5. Therapy that requires me to walk
6. All of my therapy exercises during my rehabilitation
7. My therapy every day that it is scheduled
8. The exercises my therapists say I should do, even if I don't' understand how it helps me
9. My therapy no matter how I feel emotionally
10. My therapy no matter how tired I feel
11. My therapy even though I may already have other complicating illnesses
12. My therapy regardless of the amount of pain I am feeling

Table 2. Demographic Information

	N =28
Age	47.25 (13.9) Range: 16 to 75
Sex	16 males 12 females
Mechanism of injury	12 Traumatic 16 Nontraumatic
Injury	Isolated ACL rupture (n = 2) ACL rupture with meniscal involvement (n = 4) Meniscal tear (n = 8) Patellofemoral pain (n = 4) Generalized knee pain/OA (n = 9) Other (n =1)
Surgery	Isolated ACL reconstruction (n = 2, 1 revision) ACL reconstruction with mensical involvement and/or condroplasty (n = 4, 1 revision) Meniscectomy (n =3) Meniscectomy with condroplasty or loose body removal (n =4) TKA (n =3, 1 bilateral) Diagnostic arthoscopy (n =1)
Previous knee surgery or injury	ACL reconstruction (n =4) Meniscectomy (n =1) Unspecified knee surgery (n =2) Ligamentous injury (n =1) Knee OA (n =1)

in sex, mechanism of injury (traumatic or nontraumatic), and surgical status (surgical or nonsurgical) between subjects who were included for analysis and those excluded. In the entire sample, a hierarchical regression analysis was performed using the IKDC subjective form as the dependent variable, and the following independent variables: (1) demographic information (sex and age), (2) pain intensity measured by the VNRS, and (3) psychosocial factors (TSK-11, KA-SES and MSERO scores). Independent samples t-tests were used to determine group differences (traumatic vs. nontraumatic and surgical vs. nonsurgical) in scores on the TSK-11, KA-SES, and MSERO. Finally, an analysis was conducted to determine Pearson's correlations between scores on the TSK-11, KA-SES, and MSERO in the entire study population. Data analysis was conducted with SPSS version 15 for Windows (SPSS Inc, Chicago IL) and an interactive Chi square calculator.[25] A p-value of less than .05 was considered statistically significant.

RESULTS

Forty-one subjects were seen for evaluation of knee injury during the two 8-week internship periods. Ten subjects were excluded from consideration secondary to inability to read or comprehend questionnaires. Two subjects were then excluded because they failed to return completed questionnaires. Finally, one subject's questionnaires were removed from analysis because less than 90% were filled out to completion. Six subjects did not have 100% complete but still met the criteria for inclusion. After exclusion, 28 (16 males, 12 females) subjects remained for consideration in this study. Five subjects had bilateral involvement. Based on mechanism of injury, the subjects were divided in traumatic (n = 12) and nontraumatic (n = 16) groups. Based on the surgical status, subjects were divided into surgical (n = 17) or nonsurgical (n = 11) groups. Demographic information can be found in Table 2.

No significant differences in age, sex, mechanism of injury, or surgical status were found between the subjects included or excluded for analysis (p = .24, .51, .71, .38). The entire regression model accounted for 67% of the variance in IKDC subjective form scores in the entire study population (Table 3). Only the final step, in which the psychosocial factors were added, did the model become significant (p < .001), and TSK-11 and KA-SES were significant predictors in the model (p = .04, < .01). Figures 2 and 3 show the negative, univariate association between IKDC subjective form scores with TSK-11 scores (r =-.559, p < .01) and positive, univariate association with KA-SES scores (r = .651, p < .001).

Subjects with traumatic injury had higher TSK-11 scores than those with a nontraumatic injury [26.8 (4.7) vs. 22.4 (4.0), p = .01]. No significant difference in TSK-11 scores was demonstrated between subjects who were surgical compared to nonsurgical (p = .13). No significant differences were found in KA-SES or MSERO scores between the mechanism of injury groups (p = 1.00 and .55, respectively) or the surgical status groups (p =.70 and .13, respectively).

The KA-SES scores demonstrated a significant negative correlation with TSK-11 scores (r=-.453, p = .02). No significant associations were found between MSERO scores and the TSK-11 or KA-SES scores (p = .08 and .06, respectively).

DISCUSSION

The purpose of this study was to examine the association of fear of movement/reinjury and self-efficacy with self-report of function in a group of subjects after knee injury at initiation of rehabilitation. In support of the authors' hypothesis, scores on the TSK-11 and KA-SES were found to be significant predictors of IKDC subjective form scores. The secondary aim was to: (1) investigate the difference in levels of psychosocial factors between subgroups based on mechanism of injury and surgical status, and (2) to determine the correlation between scores on the fear of movement/reinjury and self-efficacy questionnaires. The data partially supported the authors' hypothesis regarding group differences in psychosocial factors based on injury demographics. Subjects with traumatic mechanism of injury were found to have significantly higher scores on the TSK-11 than those with nontraumatic mechanism of injury; however, no differences were found between surgical and nonsurgical subjects. Similarly, the data partially supported the authors' hypothesis that correlations would exist between psychosocial questionnaire scores because a correlation was found between scores on the TSK-11 and KA-SES, but no associations existed with the MSERO.

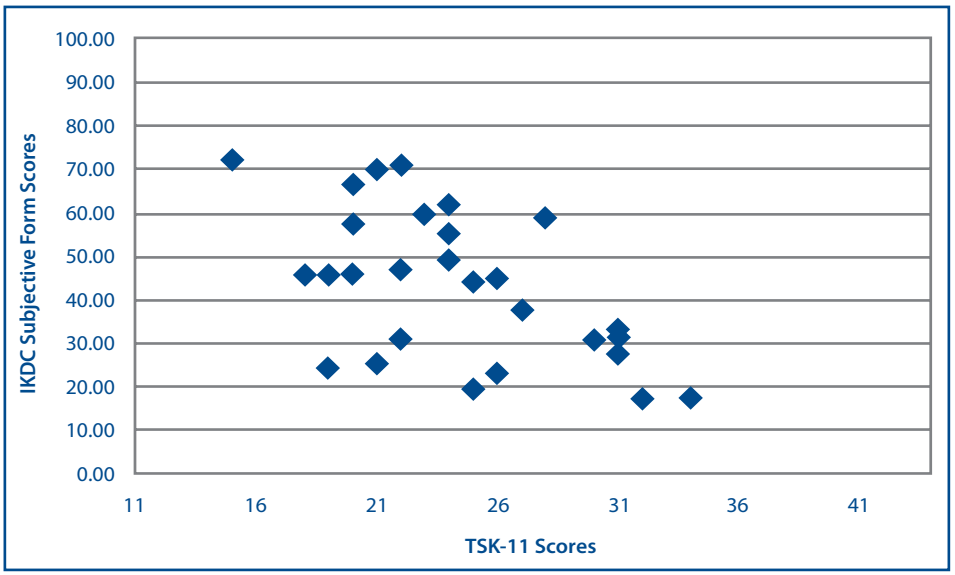

Figure 2. The association between IKDC subjective and TSK-11 scores (-.599, p = .002).

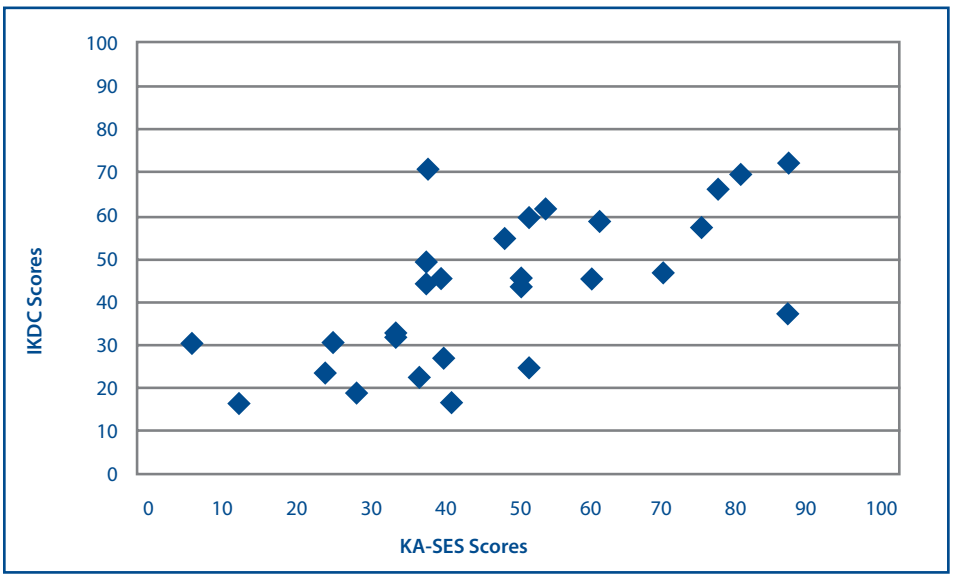

Figure 3. The association between IKDC subjective form and KA-SES scores (r = .651, p < .001).

This study is unique in investigating these psychosocial factors together in knee populations, and the correlation between fear of movement/reinjury and self-efficacy in the same subject pool. Previous studies have examined relationships between functional outcomes and psychosocial factors in populations with a single diagnosis (post-ACL reconstruction, OA, etc).[3,4,9,22] However, this study analyzed a population of subjects that contained a wide variety of diagnoses which are common to an outpatient orthopaedic physical therapy clinic.

The results of the regression model indicate that, after adjusting for demographic information and pain intensity, fear of movement/reinjury and self-efficacy are significant predictors of self-report of function in subjects at the beginning of knee rehabilitation. In the final step of the model, scores on the TSK-11 and KA-SES demonstrated significant prediction value which indicates that fear of movement/reinjury and activity self-efficacy may be important factors to address at the initiation of rehabilitation activities for patients with knee injury. The beta values indicate that a higher fear of movement/reinjury and lower activity self-efficacy are related to a decrease in self-report of function. This is in concordance with previous studies that demonstrated lower self-report of function is separately associated with both higher fear of movement/reinjury[3,9] and activity self-efficacy.[4]

The MSERO scores were not a significant factor in the regression model. In this study we used a 10-item abbreviated version of the Self-Efficacy for Rehabilitation Outcome Scale; yet, in a previous study, higher scores on the original 12-item version were associated with an improved self-report of function and functional performance after THA or TKA.[13,21,22] Additionally, it demonstrated no correlation with scores on the TSK-11 or KA-SES in this study sample. Therefore, these results may be a reflection of the decreased validity of the outcome measure for all populations of knee injury, as previous studies have examined rehabilitation self-efficacy only in populations post-TKA or THA.[13,21,22] One explanation may be a ceiling effect present in this study's population due to variation of activity level present in subjects. Subjects averaged 90.5 out of a maximum score of 100, which would be unexpected at initiation of rehabilitation.

Subjects with a traumatic mechanism of injury had significantly higher scores on the TSK-11 than those with a nontraumatic mechanism of injury at baseline. This indicates that at the initiation of rehabilitation for patients with a traumatic knee injury may require increased attention to fear of movement/reinjury. The sudden onset of a traumatic injury possibly serves to elevate the subject's fear of movement/reinjury and initiate a protective response during movement.[26] Additionally, the gradual onset of a nontraumatic injury may have a decreased impact on this psychosocial factor. The traumatic group demonstrated a score increase of greater than 4 points from the nontraumatic group, which meets the criteria for an important difference in fear of movement/reinjury reported by Woby et al[14] in patient population with low back pain (Sensitivity = 66%, Specificity = 67%). However, unexpectedly, no significant difference was demonstrated in TSK-11, KA-SES, or MSERO between the surgical status groups. It is important to emphasize that measurements were taken at the initiation of rehabilitation, and differences in fear of movement/reinjury and self-efficacy may demonstrate increased or decreased margins at different points during the rehabilitation process in either the mechanism of injury or surgical status groups.

Fear of movement/reinjury or self-efficacy should not be interpreted as predictors of future self-report of function during knee

Table 3. The Results of the Hierarchical Linear Regression Model for the Entire Sample with IKDC Subjective Form Scores as the Dependent Variable

	Independent Variables	Standardized Coefficients (Beta)	P value of variable	R Square	P value of model
Step 1	Age Sex	-.185 .000	.40 1.00	.034	.65
Step 2	Age Sex Pain intensity	-.056 -.202 -.393	.80 .40 .08	.152	.26
Step 3	Age Sex Pain intensity TSK score KA-SES score MSERO score	-.329 -.048 -.183 -.349 .490 .100	.05 .78 .23 .04 <.01 .49	.818	<0.001

rehabilitation based on these findings. However, it may be important to determine those patients at initiation of rehabilitation who have elevated fear of reinjury or decreased self-efficacy. Avoidance behaviors connected to fear of movement/reinjury have been described as a cycle that leads to continued disuse and possible increased disability.[5] Literature focused on subjects with acute low back pain demonstrated a correlation between baseline fear of movement/reinjury and future decreased self-report of function, and, therefore, interventions aimed at reduction of this pain-related fear may prevent the development of nontraumatic low back pain.[27] A similar correlation between psychosocial factors and future functional outcomes may exist in patients after knee injury.

Several limitations to this study should be noted. The sample size was limited and included multiple diagnoses. While the authors maintain the importance of examining psychosocial factors across different diagnoses, a larger representation would be preferred in future studies. Second, only data collected at the initial evaluation was analyzed. In the future, it will be important to investigate the prognostic value of initial characteristics and develop minimal scores for meaningful clinical change in TSK-11, KA-SES, and MSERO scores for patients after knee injury. Finally, even though the KA-SES and MSERO were based on validated questionnaires, our modified versions have not been previously validated.

A goal for future research in this area is to determine, through longitudinal studies, how fear of movement/reinjury and self-efficacy change in individuals during knee rehabilitation and how psychosocial change impact changes in functional outcomes. The study reported here may highlight the important psychosocial constructs for future longitudinal studies, and future studies should analyze how these changes in psychosocial factors affect both self-report of function, performance, and knee impairment outcomes in subjects across multiple diagnoses. A future longitudinal study design will allow us to begin to develop a minimal score for meaningful change in fear of movement/reinjury and self-efficacy in subjects after knee injury. Further research is needed in the development of a valid tool for measurement of rehabilitation self-efficacy which can be used with all knee injury diagnoses. Moreover, additional studies are also needed to determine the validity of the KA-SES.

In conclusion, increased fear of movement/reinjury and decreased self-efficacy may be an important predictor of reduced self-report of function in subjects after knee injury at the initiation of rehabilitation. Additionally, subjects with traumatic mechanism of knee injury may be prone to increased baseline fear of movement/reinjury.

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Association of Pain Related Beliefs with Disability and Pain in Patients with Foot and/or Ankle Pain: A Case Series

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Scott Greenburg, PT, DPT[2]
Mark Bishop, PhD, PT[3]

ABSTRACT

Background: There is little literature describing the application of the Fear Avoidance Model in patients with foot and/or ankle pain.

Purpose: To describe fear of movement/(re) injury, initial pain intensity, and self reported disability in a group of patients with foot and/or ankle pain receiving conservative interventions in a musculoskeletal outpatient setting.

Case Description: Four patients underwent a course of conservative treatment for foot and/or ankle pain. Each patient was given self report questionnaires to measure his or her fear of movement (Tampa Scale of Kinesiophobia-11) and their current level of function (Lower Extremity Functional Scale) upon initial evaluation and at a predetermined follow-up date. Other outcome measures included pain intensity based on a numeric pain rating scale. All 4 patients received similar flexibility and strength exercises, 3 patients received arch tape, and 3 received soft-tissue massage.

Outcomes: Initial TSK-11 scores ranged from 17 to 29 and LEFS scores from 37 to 72. All 4 patients reported meaningful reduction in their worst pain. Two patients showed significant improvements in TSK-11 and LEFS scores.

Discussion: In this case series the patients who showed meaningful reductions in fear demonstrated significant functional improvements. Further research is needed to better describe the relationship between fear, pain intensity, and disability in patients with foot and/or ankle pain.

Key Words: *kinesiophobia, fear, lower extremity, rehabilitation, physical therapy*

INTRODUCTION

The foot and/or ankle are a common source of pain and disability. Approximately 2 million Americans per year are affected by foot pain.[1] Garrick et al[2] reported that as high as 25% of sports injuries have been attributed to the foot or ankle. Ankle sprains are one of the most commonly reported sports related injuries, accounting for up to 45% of all injuries in some sports. Other injuries affecting athletes as well as the general population include plantar fasciitis, and tendonitis of either the peroneal tendon or the tibialis posterior tendon. Of these, plantar fasciitis is the most common, affecting as much as 10% of all Americans.[1]

Outcomes of conservative treatment range widely among diagnoses, with as high as 74% of patients with ankle sprains experiencing symptoms up to 4 years after injury.[3] Of these 37% did not return to their sport. Many patients with posterior heel pain (PHP) have reported complete resolution of symptoms on long-term follow-up (89.5%),[4] though it has been reported that as high as 42% of patients experience residual pain 2 years after initiation of treatment.[5] Posterior heel pain also can affect patients' level of function and DiGiovanni et al[5] reported that 23% of patients with PHP still report limitations with recreational activities at 2-year follow-up.

Factors affecting the development of foot and ankle pain have been widely studied. In 2003, Riddle et al[6] reported that ankle dorsiflexion range of motion (DF ROM) of 0° or less results in a 23% chance of developing plantar fasciitis. Patients with a body mass index (BMI) of greater than 30 kg/m^2 or an occupation requiring prolonged standing (odds ratios of 5.6 and 3.6 respectively) were also at a higher risk of developing plantar fasciitis. These factors were confirmed in a 2006 systematic review reporting that decreased DF ROM, increased BMI, and prolonged standing were associated with the development of chronic PHP.[1] Other factors associated with the development of foot and ankle pain include rear foot and forefoot alignment, subtalar motion, and medial arch height, although the research findings are inconsistent. Many of these inconsistencies stem from the limited reliability of measurement techniques used to evaluate foot alignment[7] and the difficulty of directly determining subtalar position. It may therefore be beneficial to study other factors that may have an influence on the development of foot and/or ankle pain and disability.

A recent review written by Maaike Leeuw and collegues describes the development of what is now commonly known as the Fear-Avoidance Model of Pain.[8] This model describes how a patient's perception of pain can affect his or her pain intensity, disability, and the development of chronic pain. The model places patients in 2 categories: confronters and avoiders. Confronters perceive pain as nonthreatening, tend to experience less interference with daily activities, and thus have a quicker recovery. Avoiders interpret pain as threatening and resort to adaptive behaviors, avoiding activities that the patient associates with the pain. This "avoidance" behavior can then lead to further disuse, disability, and the development of chronic pain. This model has been validated in patients with low back pain,[9-13] the shoulder,[14] and the knee,[15] but little evidence exists to make this association in patients with foot and/or ankle pain.

Kori et al[16] defined a specific type of fear called kinesiophobia as "an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury." It has been proposed that kinesiophobia can be used as a predictor of disability and participation in patients with

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chronic low back pain or knee pain.[10,11,15] Patients with elevated levels of this type of fear may resort to the avoidance behaviors as described above and thus develop further pain and disability. We hypothesize that a similar finding may be true in patients with foot and ankle pain. Additionally, accurately assessing levels of kinesiophobia in patients may also help guide clinicians in the development of appropriate treatment plans.

The purpose of this case series is to describe fear of movement/(re)injury, initial pain intensity, and self-reported disability in a group of patients with foot and/or ankle pain receiving conservative interventions in a musculoskeletal outpatient setting.

CASE DESCRIPTIONS

Four patients with a diagnosis related to foot and/or ankle pain were referred to an outpatient sports medicine physical therapy clinic in a major hospital system in Florida. Each patient was evaluated and treated by a doctoral student in University of Florida Doctor of Physical Therapy Program.

Impairment measures included ankle dorsiflexion range of motion (DF ROM) and an 11-point numeric pain rating scale (NPRS). The NPRS ranged from 0 (no pain) to 10 (worst pain imaginable). The NPRS has been found to be a reliable and valid measure of clinical pain intensity,[17,18] with a 2-point change needed for clinical significance.[19] Ankle ROM was measured using a standard goniometer; the patient was placed in long-sitting, with both feet extending off the plinth to allow for unrestricted movement. One arm of the goniometer was placed on the lateral side of the ankle, bisecting the fibula, the axis at the base of the foot, and the other arm bisecting the 5th metatarsal. Goniometric measurement of ankle dorsiflexion has been described to have sufficient intrarater and interrater reliability (ICC ≥ 0.70).[20] Dorsiflexion ROM was chosen because it has been associated with the development of chronic foot pain.[1]

Psychological distress was estimated using the Tampa Scale for Kinesiophobia-11 (TSK-11). The TSK-11 is a 44-point scale designed to assess a person's fear of movement and reinjury; it is a shortened version of the original TSK. The TSK-11 has been found to have good internal consistency (α=0.79), test–retest reliability (ICC=0.81, SEM=2.54), responsiveness (SRM = -1.11), concurrent validity, and predictive validity.[21] It was also determined by Woby et al[21] that a change of 4 points was clinically meaningful.

Ankle function was determined by the Lower Extremity Functional Scale (LEFS). The LEFS is an 80-point scale that measures self reported impact of lower extremity dysfunction on everyday activities. It has been found to have excellent internal consistency (α=0.96), test-retest reliability (R=0.86), and construct validity (r=0.80); a 9-point change determined to be clinically meaningful.[22]

All 4 patients underwent a similar progression of exercises, each listed in Table 2. Table 3 presents a detailed description of the progression of the fourth patient's exercises.

PATIENT 1

History

This patient was a 21-year-old female referred from a primary care physician for insidious onset of bilateral peroneal tendonitis and arch hyperpronation. This patient had a 12- year history of bilateral foot, ankle, and knee pain, with a history of right and left meniscal injuries 6 years ago. The patient's chief complaint is constant, aching, posterior heel pain, with the pain extending proximally to both knees. The pain is aggravated by running, wearing sandals, and descending stairs and eased by avoiding the offending activities, ice, and wearing tennis shoes. The patient reports her pain is

Table 1. Tests and Measures: Initial Examination

Patient/Diagnosis	Ankle PROM (Degrees)(right/left)				JT Mobility			Strength*(right/left)				Flexibility (degrees) (right/left)
	PF	DF	Inv	Ev	TC	ST	1st MTP	PF	DF	Inv	Ev	Soleus
1 Peroneal Tendonitis	50/50	7/7	17/17	40/40	WNL	Hyper	Hyper	5/5	5/5	25/35	33/25	NT
2 Plantar Fasciitis	55/65	1/10	60/60	10/17	WNL	WNL	Hypo	NT	4/5	23/36	34/39	32/40
3 Ankle Sprain	53/65	10/10	30/30	10/20	WNL	WNL	WNL	NT/4	4/5	12/31	16/31	21/30
4 Post Tibialis Tendonitis	55/60	10/13	30/30	10/10	WNL	Hyper	WNL	NT	5/5	26/31	28/21	28/32

SPECIAL TESTS						
Patient	Navicular Drop	Obers	Ant Drawer	Talar Tilt	ER	
1	+	+	NT	NT	NT	
2	+	NT	NT	NT	NT	
3	NT	NT	-	-	-	
4	-	NT	NT	NT	NT	

PF=plantar flexion, DF=dorsiflexion, Inv=inversion, Ev=Eversion
TC=talocrural, ST=subtalar, 1st MTP=1st metatarsal-phalangeal
*PF/DF strength on 0-5 scale; Inv/Ev strength in lbs measured by a hand held dynamometer
Soleus flexibility measured by passive DF in standing,
Navicular drop "+" if greater than 10mm difference

Table 2. Interventions

	Intervention/Patient	1	2	3	4
Warm-up	Stationary Bike	3	1	2	8
Flexibility	Gas/Sol Stretch	4	1	3	9
Strengthening	Thera-Band® (DF, PF, Inv, Ev)	3	1	3	9
	Calf Raises, Step, Bilateral	-	1	2	8
	Shuttle Toe Raises	3	-	2	5
	Soleus Press	1	-	-	6
	Wobble board mini-squats	-	-	1	-
	Hip SLR: abd and ER	3	-	-	-
Balance/ Proprioception	SLS with rebounder ball toss	3	-	2	8
	Balance Beam Lateral Step Downs	1	-	1	5
	Airex 3 plane lateral steps	-	-	1	5
	Trampoline Jog	-	-	-	1
Modalities	STM	1	1	-	6
	Arch Tape	1	2	-	5
	Ice	3	-	3	9
Visits	Length of episode (weeks)	4	1	3	5
	Total Visits (including IE)	4	2	3	9

The number in each cell represents the total number of times each patient performed the given intervention during the episode of care

limiting her ability to participate in various recreational activities including weight lifting and running. She reported receiving prior physical therapy for her condition, consisting of stretching and strengthening exercises. Aside from the history of meniscal injuries, the patient reported no other significant medical history.

Tests and Measures

The patient presented in the clinic wearing sandals, which she states she wears most of the time. She rated her pain 5/10 currently, 9/10 at its worst, and 5/10 at best, with the aforementioned aggravating activities. The patient scored 17/44 and 72/80 on the TSK-11 and LEFS respectively. Upon observation, calluses were noted on the medial aspect of the first metatarsalphalangeal (MTP) joint and base of the distal phalanx of the great toe, bilaterally. Palpation revealed tenderness over the distal Achilles tendon, posterior tibialis tendon, and distal peroneals, all bilateral. The patient reported that her Achilles tendon is the primary area of pain. It was also noted that the patient was mildly tender to palpation throughout both lower extremities. Ankle DF ROM was limited to 7° bilaterally. See Table 1 for complete list of measures. To assess gait mechanics the patient was asked to walk barefoot for approximately 10 meters while the therapist noted any gait deviations. This observational gait assessment revealed that the patient walked with an abducted forefoot, prolonged pronation, and associated medial whip. Rearfoot alignment was measured by positioning the patient in prone and placing the patient's foot in maximum dorsiflexion while maintaining subtalar neutral. In this position, calcaneal alignment was noted relative to a line bisecting the patient's Achilles tendon. Upon assessment the patient was noted to have increased rearfoot valgus, left greater than right. Joint specific mobility evaluations led to the determination that the patient's subtalar and first MTP were hypermobile, bilaterally. The patient also demonstrated a navicular drop of greater than 10 millimeters.

Evaluation

Tenderness of the distal peroneal tendons, a positive navicular drop, and the patient's foot mechanics during gait confirmed the diagnosis of peroneal tendonitis and arch hyperpronation, exceptions included Achilles tendon and tibialis posterior tendon pain. The additional locations of pain may have been a result of a compensating gait pattern, though it is difficult to determine which symptom preceded the others due to the chronicity of the patient's condition. It was determined that the patient's impairments were consistent with the Musculoskeletal Practice Pattern E: Impaired joint mobility, motor function, muscle performance, and range of motion associated with localized inflammation, as described by the *Guide to Physical Therapist Practice*.[23] The patient was to be seen 1 time per week for 4 to 6 weeks or until all her goals were met.

Intervention

The initial intervention consisted of soleus and gastrocnemius stretches, a modified version of the Double-X taping method for arch support, and ice. The patient was given a home exercise program (HEP) of the above exercises, instructed to wear the arch tape for 24 hours and report any change in symptoms, and to discontinue wearing sandals for the short term. On the subsequent visit, one week after initial evaluation, the patient reported continued use of her sandals, and she attended a football game while wearing sandals after which she had an acute exacerbation of her symptoms. The patient was reminded of the importance of complying with her HEP and to discontinue use of sandals. The patient was prescribed additional exercises as documented in Table 2. One week later, the patient's pain had decreased to 0-3/10, but no change associated with the arch tape; therefore, we decided to discontinue the application of the arch tape. Due to the chronic nature of the patient's condition, we decided to initiate soft tissue massage (STM) to facilitate an inflammatory response and promote healing. Upon the next visit, the patient reported increased symptoms that she attributed to the STM; therefore, we discharged the use of STM for the next session.

Outcomes

At the 2 week follow-up the patient scored higher on the TSK-11 (22/44) and the LEFS (74/80). Only the change in the TSK-11 score was significant. Pain was reported as 0/10 currently and 3/10 at worst in the last week.

PATIENT 2

History

This patient was a 25-year-old female referred from a primary care physician for insidious onset of right sided plantar fasciitis. The patient's chief complaint was a constant, sharp medial heel and arch pain that increases with weight bearing activities and is eased by rest. The pain is worse in the morning, eases with activity, and increases again in the evening. The patient reported her symptoms began approximately 14

Table 3. Patient 4 Treatment Log

Intervention/Visit #	IE	2	3	4	5	6	7	8	9
Arch Tape; R	X		X	X			X	X	
Stationary Bike		10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min
STM-post tib;R		10 min	10 min	10 min	8 min		8 min	10 min	
Stretch; R (Gas/Sol) Incline & rope	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec	2 X 60 sec
Thera-Band® (DF, PF, Inv, Ev); R	Yellow 1 X 20	Yellow 1 X 30	Yellow 1 X 40	Yellow 1 X 50	Red 1 X 30	Red 1 X 20	Red 1 X 50	Red 1 X 60	Blue 1 X 30
Calf Raises, Step, Bilateral		1 X 20	1 X 30	1 X 30	1 X 40	2 X 25	2 X 25	2 X 25	3 X 20
Shuttle Toe Raises; R				1.5 bands 1 X 20	1.5 bands 1 X 30		1.5 bands 2 X 20	1.5 bands 1 X 25	1.5 bands 1 X 25
Soleus Press; R				20# 1 X 20	20# 2 X 15	20# 2 X 20	25# 2 X 15	25# 2 X 20	25# 2 X 25
Trampoline Jog						8 min			
SLS with rebounder tball toss; R		4# ball 1 X 30	4# ball 3 X 20	4# ball 3 X 20	4# ball 3 X 30	4# ball 3 X 30	4# ball 1X100	4# ball 4 X 30	4# ball 4 X 30
Balance Beam Bumps					10 lengths	10 lengths	10 lengths	10 lengths	10 lengths
Airex 3 plane lateral steps					1 X 30	1 X 30	1 X 30	1 X 30	1 X 30
Ice; R	10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min	10 min

# = pounds
R = exercise performed by right lower extremity; R/L = exercise performed by right and left lower extremity separately
STM = Soft Tissue Mobilization; Gas/Sol = Gastrocnemius and Soleus; DF, PF, Inv, Ev = Dorsiflexion, plantarflexion, inversion, eversion
SLR = Straight Leg Raise

months ago, with an acute exacerbation 7 months prior to her initial evaluation. The patient had been self treating her condition by massaging the arch of her right foot with a tennis ball and a frozen bottle of water with little relief. The patient reports her pain is limiting her ability to participate in several recreational activities including weight lifting and hiking. She also reports difficulty walking to and from her bus stop which is approximately a half mile away from her home. The patient has a history of multiple sport-related ankle sprains; the patient reported no other significant medical history.

Test and Measures

The patient presented in the clinic wearing sandal-type shoes. She rated her pain as 7/10 currently, 10/10 at worst, and 4/10 at best. Initial TSK-11 and LEFS scores were 29/44 and 37/80, respectively. Observation revealed calluses present bilaterally over the plantar surface of the third and fourth metatarsal heads and the first interphalangeal joint. Significant rearfoot and forefoot varus was noted bilaterally in nonweight bearing (NWB). Palpation revealed tenderness to the plantar fascia with the greatest irritation at the medial tubercle of the calcaneus. Tenderness was also noted over the right distal peroneal tendon. Pain was noted with resisted ankle plantar flexion, dorsiflexion, inversion, and eversion. See Table 1 for complete list of measures. Gait analysis revealed an antalgic gait pattern with decreased push-off on the right during terminal stance. Barefoot walking elicited 8/10 pain; when tape was applied to the patients right foot to support her medial longitudinal arch her pain decreased to 4/10 with barefoot walking.

Evaluation

Insidious onset, tenderness over the medial calcaneal tubercle, limited ankle DF ROM, and increased pain in the morning are consistent with the diagnosis of plantar fasciitis. It was determined that the patient's impairments were consistent with the Musculoskeletal Practice Pattern E: Impaired joint mobility, motor function, muscle performance, and range of motion associated with localized inflammation, as described by the *Guide to Physical Therapist Practice.*[23] The patient was to be seen one time per week for 4 to 6 weeks or until all her goals were met.

Intervention

Initial treatment included the application of tape, using the modified Double X method, to support the patient's medial longitudinal arch. The patient was instructed to wear the tape for 24 hours, and to discontinue wearing sandals; she was to wear tennis shoes instead. No other interventions were provided at this time to accurately determine the degree to which the arch taping may decrease the patient's pain. Three days after the initial evaluation, the patient returned for follow-up and reported significant reduction in pain, 3/10 when wearing the arch tape and 5/10 when the tape is removed. The patient was then prescribed flexibility and strength exercises as noted in Table 2.

Outcomes

The patient was seen 3 days after the initial evaluation and reported reductions in subjective pain report during barefoot walking from 8/10 to 5/10 (without arch taping

applied). Her TSK-11 score was reduced to a 25/44 and her LEFS score increased to 50/80, both clinically significant changes.

PATIENT 3

History

This patient was a 20-year-old female referred from a primary care physician with diagnosis of a right ankle sprain. The patient's chief complaint was intermittent, aching anterior and lateral ankle pain that is aggravated by running and descending stairs and eased by rest and ice. The patient reports she injured her ankle approximately 3 weeks prior to the initial evaluation. The injury occurred when she was descending a flight of stairs, her ankle 'gave way,' and she fell down the remaining 3 steps. After seeing the physician, she was placed on crutches for 1 week, then placed in a walking boot for 1 week, and has been weight bearing as tolerated for the week prior to attending physical therapy. The patient is a college student and reports her pain is limiting her ability to walk around campus, ascend and descend stairs, and to participate in recreational activities including running and weightlifting. The patient also reports that she suffered a similar injury to her left ankle, 2 months prior to injuring her right ankle.

Test and Measures

The patient presented wearing a compressive sleeve on her right ankle, without crutches, and with an antalgic gait. The patient's subjective pain report was as follows: 3/10 currently, 7/10 at its worst, and 2/10 at its best. Initial TSK-11 and LEFS scores were 27/44 and 59/80 respectively. Observation revealed minimal ecchymosis surrounding the patient's distal right Achilles tendon. Palpation revealed tenderness along the anterior talofibular (ATF) ligament and calcaneofibular (CF) ligament of the right foot. See Table 1 for complete list of measures.

Evaluation

The patient's mechanism of injury, presence of mild ecchymosis around the ankle joint, and tenderness over the ATF and CF ligaments were consistent with the diagnosis of a right first degree eversion ankle sprain. The patient's impairments were consistent with the Musculoskeletal Practice Pattern D: impaired joint mobility, motor function, muscle performance, and range of motion associated with connective tissue dysfunction. The patient was to be seen 1 time per week for 4 to 6 weeks or until all her goals were met.

Intervention

Initial treatment included gastrocnemius and soleus stretches to improve the patient's ankle ROM, open-chain Thera-Band® exercises to strengthen all the patient's ankle planes (plantar flexion, dorsiflexion, inversion, and eversion). She also received an ice pack to place over her ankle for 10 minutes. The patient was given a home exercise program (HEP) of the above exercises. On the patient's second visit, she reported improved function in the last week, stating she is able to walk from her car to class without problems. The patient did report standing at a football game for several hours over the weekend and her pain increased to 5/10 after the game. Mild swelling was still present over her right ankle, but most likely from prolonged standing at the football game. The patient reported 1/10 pain today therefore we progressed her. One week later the patient returned to our clinic reporting 0/10 pain most of the time, with 3/10 pain "sometimes" at the end of the day. We continued the exercise program and added exercises as noted in Table 2.

Outcomes

The patient was seen once a week for 3 weeks, including the initial evaluation. Upon 2 week follow-up, the patient's subject pain report decreased from 7/10 at worst, to 3/10 at worst, and was currently 0/10. While she showed a significant decrease in subjective pain report, the patient's LEFS score increased only 5 points to 64/80. Her TSK-11 score remained the same, 27/44.

PATIENT 4

History

This patient was a 21-year-old female referred from a primary care physician for insidious onset of right sided posterior tibialis tendonitis. The patient's chief complaint was intermittent, aching pain surrounding the medial aspect of her right ankle which is aggravated by any weight bearing activity, especially dancing and eased by rest and ice. These symptoms have been present for approximately 1 week. The patient was an amateur West African dancer and the pain was limiting her ability to participate in her dance class and in performances. The patient reports no previous treatment for her condition. Her past medical history includes a fractured right ankle 7 years ago: the patient reported no other significant medical history.

Test and Measures

The patient presents in the clinic wearing tennis shoes, without an antalgic gait. Her subjective pain is reported as 1/10 currently, 9/10 at its worst, and 1/10 at its best. Upon observation the patient was noted to have the following, bilaterally: a prominent navicular bulge, pes planus foot structure, and callouses present between her second and third metatarsal heads. In prone, the patient was noted to have a mild rearfoot varus foot alignment, bilaterally. Palpation revealed tenderness over her right posterior tibialis tendon. Ankle DF ROM was measured to be 10° on the right and 13° on the left. This difference may not be clinically meaningful and could be due to measurement error. Ankle PF strength was not tested secondary to pain. See Table 1 for complete list of tests and measures.

EVALUATION

Tenderness of the posterior tibialis tendon, pain with ankle plantar flexion, and the patient's foot type are consistent with the diagnosis of posterior tibialis tendonitis. Based on her impairments, the patient fits the Musculoskeletal Practice Pattern E: impaired joint mobility, motor function, muscle performance, and range of motion associated with localized inflammation, as described by the *Guide to Physical Therapist Practice*.[23] The patient was to return for treatment 2 times per week for 4 to 6 weeks or until her goals were met.

Intervention

Initial treatment included gastrocnemius and soleus stretches and Thera-Band® exercises similar to patient 2. She also received an ice pack to place over her ankle for 10 minutes. Tape was applied to support her medial longitudinal arch and decrease the tension on her posterior tibialis tendon. The patient was instructed to wear the tape for 24 hours and given a HEP of the above exercises. She as also advised to discontinue participating in her dance class for 2 weeks.

On the second visit, the patient reported compliance with her HEP, though she did experience some soreness in her posterior tibialis muscle after the last treatment session. The exercise program was progressed as noted in Table 2. The following visit the patient reported an increase in symptoms after standing for several hours over the weekend at a football tailgate party. Upon palpation, the patient's right posterior

tibialis muscle was noted to have increased tone; therefore, STM was initiated to facilitate decreased muscle tone. Two days later the patient returned to the clinic and reported improved gait and 0/10 pain at the present moment. After two weeks of treatment the patient continued to report 0/10 pain at rest, with 1/10 at its worst. She also reported she attempted some "light dance moves" without an increase in her symptoms. The patient was educated to continue her HEP, we applied the arch tape and advised the patient to wear the tape during her dance class, but continue to limit the intensity of her dancing. On her next visit we added trampoline jogging to simulate, at a lower intensity, the impact on her feet of the West African style of dance. The patient performed the exercise with no increase in symptoms. Over the next 2 weeks, the patient continued to improve and we continued to progress her exercise program. The patient was educated on a self-taping method so she could continue to wear the tape during her dance class.

Outcomes

Upon discharge the patient reported 0/10 pain with her dancing, though she did report 3/10 pain during toe raises on her last visit. Dorsiflexion ROM on the left increased from 10° to 12°, not a clinically meaningful change. The patients TSK-11 score decreased from 17/44 to 13/44 and her LEFS score increased from 48/80 to 77/80, both clinically meaningful changes. The patient met all of her set goals and was discharged from physical therapy with instructions to continue her HEP and wearing arch tape during her dance.

DISCUSSION

All four patients presented with foot and/or ankle pain. Three of the 4 patients were diagnosed with nontraumatic, overuse injuries. The remaining patient was diagnosed with a traumatic ankle sprain. The duration of symptoms ranged from 1 week to 12 years. Only one of the patients had received prior physical therapy for her condition. All 4 patients reported varying levels of functional limitations and kinesiophobia.

Upon initial evaluation 3 of the 4 patients demonstrated a relationship between their TSK and LEFS scores consistent with our hypothesis. The patients with the lower TSK score tended to report a higher LEFS score (Figure 1). The fourth patient demonstrated the lowest TSK score, but reported the second lowest LEFS score. This could be due to several factors. First, she had the shortest duration of symptoms and could be in the acute phase of her condition. Also, she was the only patient involved in a high demand activity, West African Dance, and thus her perceived level of disability would be greater when compared to patients with a lower prior level of function.

Another observation that can be made is that the patients whose TSK scores showed a meaningful decrease (at least 4 points) over the course of their treatment also demonstrated the greatest clinically meaningful increase in their LEFS scores. As seen in Figure 2, patients 2 and 4 experienced a much larger percent improvement in both their TSK-11 and LEFS scores. Interestingly, patient 4 also had the lowest initial score on the TSK-11. While this patient did report high levels of initial disability as well as low levels of fear, she did demonstrate the greatest improvement in her LEFS score (60.4%), which is consistent with the fear-avoidance model described previously.

Certainly any conclusions must be tempered by the consideration that this report is a case series. As such, we did not exclude patients based on their mechanism of injury, thus our study group included both traumatic and nontraumatic injuries.

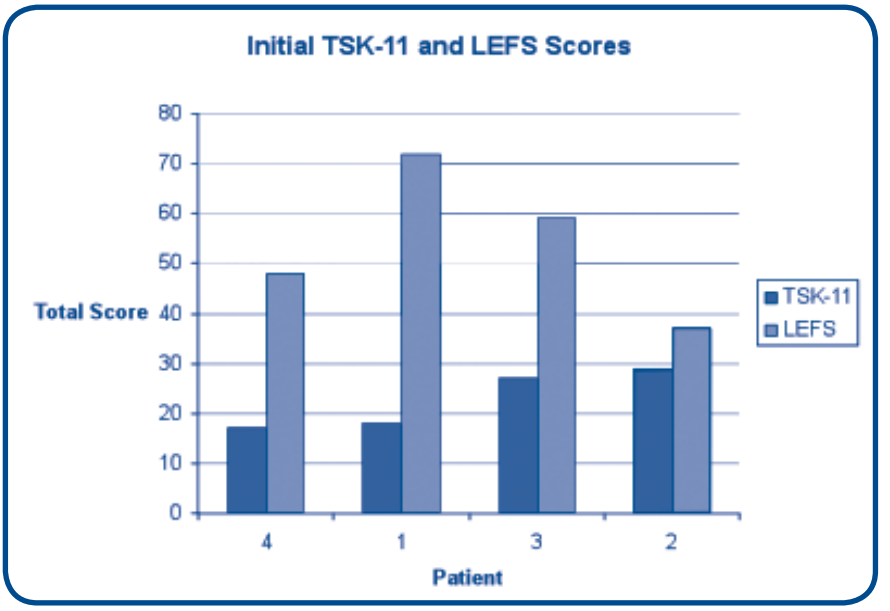

Figure 1.

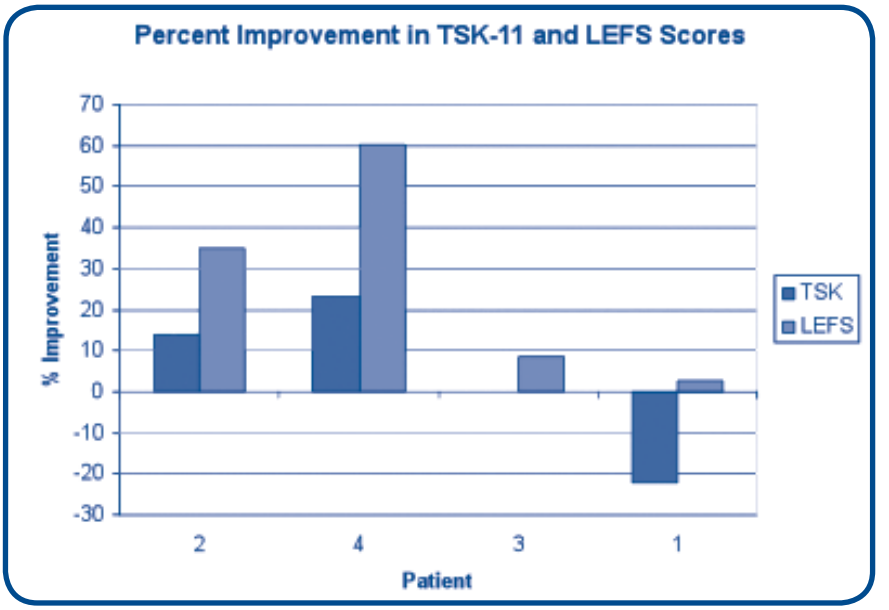

Figure 2.

Table 4. Outcome Measures

Pt.	Duration of Symptoms	Pain (worst)			#DF ROM			TSK-11 (44 possible)			LEFS (80 possible)		
		I	F	diff	I	F	diff	I	F	diff	I	F	Diff
1	12 years	9/10	3/10	-6*	7º	NT	N/A	18	22	+4*	72	74	+2
2	14 months	10/10	5/10	-5*	1º	NT	N/A	29	25	-4*	37	50	+13*
3	3 weeks	7/10	3/10	-4*	10º	NT	N/A	27	27	0	59	64	+5
4	1 week	9/10	3/10	-6*	10º	12º	+2	17	13	-4*	48	77	+29*

#affected side
*significant change
I= Initial Exam; F = Final Exam

We also included patients in the acute phase of tissue healing, as well patients with duration of symptoms greater than one year. It is reasonable to suggest that the patient with the greatest improvements may have done so primarily because she was more compliant with our recommendations and completed the full course of treatment. She was also treated at a greater frequency and thus may have had a greater treatment affect. None the less, meaningful improvements in self-reported function occurred for those patients who experienced a measurable reduction in fear.

Due to the lack of rigorous study design, no cause and effect relationships can be determined. It does appear, however, that patients with foot and/or ankle pain may display characteristics consistent with the fear-avoidance model seen in patients with low back,[9-13] knee,[15] and shoulder pain.[14] To more conclusively study this relationship, this model should be examined in a much larger group of patients, with a greater control of variable factors. Further research should focus on a demographic of patients with greater similarities in mechanism of injury (nontraumatic), duration of symptoms (acute or subacute), nonoperative versus operative and treatment protocol. Follow-up should be conducted at 6 months and 1 year to ensure sufficient time for the natural course of the condition. A more rigorous study design may allow for a better understanding of the association between fear of movement and self reported disability and pain.

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23. American Physical Therapy Association. *Guide to Physical Therapist Practice*. 2nd ed. June 2003 revision.

OSTEOBLASTS!

The Orthopaedic Section is sending out monthly "OsteoBlasts" to all members who have e-mail access. This monthly e-news will help to keep you updated on Section activities. The most recent OsteoBlast is posted to our web site as well. **Please take note: if you have an "AOL" e-mail account, you may not be receiving the Orthopaedic Section's blast e-mails. Contact Tara Fredrickson at tfred@orthopt.org if you have an alternative e-mail account you would like us to use.

CSM 2009 February 9-12

LAS VEGAS

Combined Sections Meeting
American Physical Therapy Association

Tuesday, February 10, 2009:

7:00 AM - 8:00 AM First Timers/Celebration Breakfast

10:30 AM - 12:00 PM Research Agenda

10:30 AM - 12:15 PM

- Strength Training within the First Two Weeks after Unilateral Knee Replacement Based on Medical Exercise Therapy (M.E.T): Can Intense Physical Therapy be Initiated Soon after Surgery and what are the Results?
- Movement System Impairment Diagnosis and Intervention of Cervical Spine and Temporomandibular Joint Pain Syndromes: Consideration of Adjacent Regions

CO-SPONSORSHIP
Orthopaedic Section and Section on Research:
Shoulder Impingement: Muscle Structure, Function and Rehabilitation

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Screening for Medical Conditions that May Present as Musculoskeletal Conditions in Physical Therapy Practice

12:30 PM – 2:15 PM:

- Your First 5 Years: Using Enhanced Clinical Reasoning as You Transition from Novice Clinician to Specialist
- Integration of Joint Mobilization/Manipulation and the Diagnosis and Treatment of Movement System Impairments of the Lumbar Spine
- Use of the International Classification of Functioning to Develop Evidence-based Practice Guidelines for Common Musculoskeletal Conditions: A Progress Update
- Surgical and Nonsurgical Management of Rotator Cuff Tear Arthroplasty

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Neurological Screening and Return to Participation following Mild Traumatic Brain Injury

2:30 PM - 4:30 PM

- The Missing Link: Understanding the Relationship of Spinal Dysfunction and Peripheral Function
- Lower Extremity Movement Impairments Related to Knee Injury: The Role of Muscle Strengthening and Movement Re-education
- Actualizing Physical Therapists as Primary Care Preferred Practitioners
- Evidence-based Rehabilitation Following Arthroscopic Anterior Stabilization of the Shoulder A Consensus Guideline by the American Society of Shoulder and Elbow Therapists

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Evidence Based Patient Education:
Overcoming Barriers to Health Literacy

Wednesday, February 11, 2009:

7:00 AM – 8:00 AM

- Foot & Ankle Special Interest Group Membership Meeting
- Occupational Health PT Special Interest Group Membership Meeting
- Pain Management Special Interest Group Membership Meeting

8:00 AM - 11:00 AM

- Foot & Ankle SIG Programming: The Management of Individuals with Complex Traumatic Leg, Ankle, and Foot Injuries

- Occupational Health PT SIG Programming: Beyond the Hoyer Lift: New Technology in Equipment for Patient Handling
- Pain Management SIG Programming: Fear Avoidance Behavior: State-of- the-Art Review

CO-SPONSORSHIP
Orthopaedic Section and Acute Care Section:
What You Need to Know before Exercising Patients taking Anti-Inflammatory Agents and Other Pain Medications

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Incorporating Musculoskeletal Imaging to Enhance Your Physical Therapy Practice

1:00 PM - 4:00 PM

- Joint, Muscle, but what about the Tendon? Mechanisms Underlying Tendinopathies and the Basis for Effective Interventions

CO-SPONSORSHIP
Orthopaedic Section and Oncology Section:
Orthopedic Rehabilitation: Improving Outcomes using Lymphatic System Treatments Home Program Instruction

CO-SPONSORSHIP
Orthopaedic Section and Section on Research:
Research Information Exchange Center

CO-SPONSORSHIP
Orthopaedic Section and Private Practice Section:
Physical Therapy as the Core of the Fitness/Wellness Industry: A Clinical and Business Model

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Evidence-based Guidelines for the Management of Patellofemoral Pain Syndrome

4:00 PM – 5:00 PM Rose Award Platform Presentation

5:30 PM – 6:30 PM Orthopaedic Section Social Hour

6:30 PM – 7:30 PM Orthopaedic Section Membership Meeting

7:30 PM – 9:30 PM Orthopaedic Section Awards Ceremony

Thursday, February 12, 2009:

7:00 AM – 8:00 AM

- Performing Arts Special Interest Group Membership Meeting
- Animal Rehabilitation Special Interest Group Membership Meeting

8:00 AM - 11:00 AM

- Performing Arts SIG Programming: The Foot and Ankle in Performing Artists: from Show Girls in Heels and Skaters in Boots to Barefoot Dancers and Gymnasts-Measuring, Manual Therapy and Rehabilitation, and Footwear Modifications
- Animal Rehabilitation SIG Programming: The Divine Equine

CO-SPONSORSHIP
Orthopaedic Section and Acute Care Section:
Body Mechanics is not Enough: The Case for Safe Patient Handling

CO-SPONSORSHIP
Orthopaedic Section and Private Practice Section:
You Don't Know What You Don't Know! How to Utilize Evidence-based Patient Reported Outcome Measures to Improve Care and Market Your Practice

CO-SPONSORSHIP
Orthopaedic Section and Federal Affairs Section:
Clinical Decision-Making for Patients with Low Back and Neck Pain

1:00 PM – 5:00 PM

CO-SPONSORSHIP
Orthopaedic Section and Cardiopulmonary, Research and Geriatrics Sections: The Diffuse Effects of Diabetes from the Cellular to the Population Level: Implications for Physical Therapists

1:00 PM – 3:00 PM
Concurrent Platform Presentation Sessions "A – E"

3:00 PM – 5:00 PM
Concurrent Platform Presentation Sessions "F – I"

Section Members In the News

Congratulations Adam Smith, PT, OCS for receiving the 2008 Emerging Leader Award. Adam is a current Orthopaedic Section member and served as the Orthopaedic Section Membership Chair for several years. Congratulations!

OCCUPATIONAL HEALTH SIG NEWSLETTER

Greeting OHSIG Members!

Executive Summary OHSIG Practice Analysis

We hope you all had a chance to read the Executive Summary of the Practice Analysis that was included in Vol. 20, No. 3, 2008 of OPTP. This information will be critical in developing curriculum specific to Occupational Health Physical Therapy.

Revised FCE Guidelines

The Revised FCE Guidelines were presented to the Orthopaedic Section Board of Directors Aug 13, 2008. Margot made a motion to the Ortho BOD on behalf of OHSIG BOD, the FCE Task Force, and the FCE CSM Working Group to approve the Revised FCE Guidelines as is. The motion was passed.

Lisa Culver, PT, DPT, MBA, Associate Director, Department of Practice for APTA, indicated that the Revised FCE Guideline document will next be reviewed by the Board Review Committee, in concert with agreement of the full Board to rescind the current FCE Guidelines.

Practice plans to submit a recommendation at the September Board Conference call to rescind **GUIDELINES: OCCUPATIONAL HEALTH PHYSICAL THERAPY: EVALUATING FUNCTIONAL CAPACITY** **BOD G11-01-07-11** (Program 32) contingent on the approval of the Revised FCE Guidelines submitted by Occupational Health SIG of the Orthopaedic Section. The document will be posted on the APTA website so that all APTA members would have access to this Section Guideline.

Again, many many thanks to all of those who participated in this initiative. It was truly a group effort! In addition, a special thank you to Rick Wickstrom, Gwen Simmons, Susan Isernhagen, and Margot Miller for getting the Guideline into its final format.

CSM Las Vegas Feb 8-12, 2009

It's not too early to make your plans to attend CSM Las Vegas. Below is info on Occupational Health Programming.

PRECON: Vision 2020 Actualized in the Onsite Occupational Health Setting

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. 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 evidence-based guidelines and therapeutic measures. The program will focus on 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 to a recordable pathology.

Beyond the Hoyer Lift: New Technology in Equipment for Patient Handling

This program will introduce a variety of the newer options for patient handling in therapy. Strategies for selecting equipment and interacting with vendors will also be presented. Small group case studies of patients/clients in a variety of settings will be used to help participants synthesize consideration across the care spectrum.

Advances in technology have impacted all aspects of health care, including options for the way therapists provide hands-on care to patients. New equipment can be used to assist with tasks such as transferring, repositioning, and ambulating patients. The use of equipment can promote the complementary goals of improving safety for both patient and caregiver, as well as improve the potential for rehabilitation.

Body Mechanics Is Not Enough: The Case for Safe Patient Handling (co sponsored with Acute Care Section)

Physical therapists are not immune to work-related musculoskeletal disorders or injuries. There is a long-standing belief, however, that adherence to "good body mechanics" will protect us from injury over the course of a working career, despite evidence to the contrary. The nursing profession has already begun a paradigm shift away from manual patient handling to the integration of new technology to improve both caregiver and patient safety; for example, schools of nursing have begun to teach new ways of approaching patient handling.

This program will review the evidence, discuss some of the myths about patient handling, describe current trends in safe patient handling, and suggest the impact on the physical therapy profession, including education.

More information will follow. We hope to see you there!

Sincerely,

Margot Miller, PT
OHSIG President

HEART DISEASE AND FIREFIGHTERS

Laurie Heer, PT, MS, CSS, CES

Surprisingly, the number one cause of on-the-job deaths for firefighters is sudden cardiac death. Actually, 45% of job related deaths for firefighters are cardiac related.[4] Since most cardiac deaths can be prevented with the proper identification and reduction of risk factors, this percentage is rather alarming. The workers who are trained to save lives also need help themselves to stay alive.

The job of firefighting entails many risk factors in itself including: exposures to noise, heat, smoke and particulate matter, heavy physical work, shift work, and overtime. In addition, the firefighters may have personal cardiac risk factors that put them at a greater risk to suffer a sudden cardiac death during or after a firefighting event.[1] The combination of the job of firefighting and personal risk factors contributes to the 1000 annual on-duty deaths.[4]

Many studies point to the solution to this fatal issue as one of prevention.[1,2] Firefighters must be physically fit to withstand the rigors of the job including responding to a fire or emergency at a moment's notice. In addition to the strength needed to perform specific tasks such as lifting equipment and bodies, the firefighter must be aerobically fit. Studies have shown that the firefighter needs to work at a level of 12-13 METs.[2] The firefighter also needs to work wearing heavy gear and a respirator that can compromise breathing and adds to the physical demands of the job.

Pre-placement examinations and physical abilities testing for new firefighters incorporate many of the real life firefighting activities including ladder climbs, body drags, and many anaerobic "circuit training like" situations.[6] But what happens to the volunteer force who have another work life and work as a firefighter as a service to the community? Are these people tested to see if they're fit enough for these arduous tasks?

This case study will begin to address some of these questions. I will first describe an ongoing program that I am involved with at my work. I will then introduce you to my fictional firefighter who represents a typical client that we have encountered through our program. I will take you step-by-step through my analysis of his current fitness level. Finally, I will share an exercise program that I developed for my client.

CASE STUDY: JOE FIREFIGHTER

Background Information

My employer, Medical Associates Health Care Centers, is involved in a real life Health Risk Appraisal and Fitness Assessment project with a local municipality of volunteer firefighters in LittleTown, WI. In 2006, we had 48 firefighters go through our health screening portion of the program. This portion includes completing a Health Risk Questionnaire. Then the participant undergoes fasting blood work (eg, blood glucose), cholesterol, and height/weight and blood pressure screening. If there are any cardiac risk factors present, the firefighter will see the Occupational Medicine physician to be cleared for the Fitness test. Thirty firefighters went on to have a fitness test. The reason only 30 completed the fitness test was primarily due to lack of compliance on the firefighter's part. We are currently completing the fitness tests of the "stragglers."

Our fitness test consists of the Fitnessage program which includes screening questions from the PAR Q. Then the firefighter is assessed by: Body Composition (Waist/hip ratio, Height/Weight), Cardiopulmonary (3-minute step test), Flexibility (sit and reach), and Strength Test (one minute of sit-ups, push-ups until exhaustion). As you can imagine, participation was our first challenge. The second hurdle will be designing a fitness program that the firefighters will do.

I would like to introduce Joe Firefighter, the "typical" firefighter that was part of our project:

PATIENT PROFILE: JOE FIREFIGHTER

Age:	33
Race:	Caucasian
Sex:	Male
Marital Status:	Married
Place of Residence:	Lisbon, WI

(a rural community about 20 miles northwest of Milwaukee, WI)

Occupation: Full-time factory worker during the day and Volunteer Firefighter

Health Status Questionnaire: See Attached

History of Present Illness: Through the Health Risk Assessment and the physical from the physician, it was discovered that Joe has high cholesterol and slightly high blood pressure. Joe had no unusual childhood illnesses.

Past Medical History: Denies any history of diabetes, cardiac, cancer, orthopaedic issues.

PHYSICAL EXAMINATION:

Blood pressure:	(150/94)
Pulse:	80 bpm
Respiration rate:	20 rpm
Weight:	200 pounds
Height:	6'
BMI:	27.1 increased

MEDICATIONS: NONE

LABORATORY DATA:

Fasting Blood Sugar:	**130 mg/dl** *desirable 60-99 mg/dl*
Total Cholesterol:	**241 mg/dl HIGH** *desirable < 200*
LDL:	**165 mg/dl HIGH** *desirable < 100*
HDL:	**39 mg/dl LOW** ***d****esirable ≥ 60*
Triglycerides:	**187 mg/dl borderline HIGH** *normal< 150*

RISK FACTOR ASSESSMENT:

Joe has the following cardiac risk factors: high blood pressure, high cholesterol, obesity per BMI standards, stressful job including on call volunteer hours as a firefighter. He is frequently called out after working a complete shift in his daytime job. He is also a male who is unfit and not exercising regularly. In addition his father died of a heart attack at age 60.

RELEVANT SOCIAL HISTORY:

Joe came from a family of 5 kids (2 boys, 3 girls). He played varsity high school football and wrestling. Joe graduated from LittleTown High School in 1992 and went into the Army for 4 years. Joe was in the infantry and went to Saudi Arabia for 6 months. He married his high school sweetheart, Tammy, in 1996. They have 3 kids aged 10 (Ashley), 8 (Connor) and 5 (Joey). He has worked at Quad Graphics since he was honorably discharged from the Army. He is the first shift foreman in the digital print section. Joe spends his free time going to his kids' soccer games. He also enjoys hunting and bowling. Joe states he does not participate in a regular exercise program. He has a large circle of friends and family. He attends St. John's Lutheran Church. Joe's wife, Tammy, works as the head teller in a bank. They earn about $100,000 per year which includes Joe's overtime at the factory and his firefighting salary.

FITNESS ASSESSMENT RESULTS:

Body Composition:	**21.2%**
Weight:	**200 pounds**
Waist	**36.75 inches**
Hips	**42 inches**
Flexibility (sit and reach):	**+4 (good)**
3 Minute Step Test:	**Resting Pulse 78 bpm, 119 bpm**

Using Table D-6 ACSM's Guidelines for exercise testing and prescription

12 inch step 22 steps/minute
6.8 METS X 3.5= 23.8 ml/kg min (poor) [17]

Push-ups: 25 (between good and very good)

Sit ups: 28 (excellent)

FITNESSAGE:

Biological age: 33
Body Composition: 46
Cardiorespiratory: 78
Flexibility: 20
Strength: 44
Overall Fitnessage: 50

Joe's Fitness Goals: To start a regular exercise program.

ANNOTATED BIBLIOGRAPHY:

1. CDC National Institute for Occupational Safety and Health Preventing Firefighter Fatalities Due to Heart Attacks and Other Sudden Cardiovascular Events. *NIOSH Publication* No. 2007-133.

This NIOSH publication summarizes the personal and workplace risk factors that contribute to cardiovascular disease among firefighters. These risk factors include:

2. **Exposure to fire smoke:** The two main gases in fire smoke that contribute to cardiovascular conditions include carbon monoxide and hydrogen cyanide. Carbon Monoxide can cause hypoxia and ultimately myocardial infarction. Hydrogen Cyanide will bond to hemoglobin and disrupt cellular transport of oxygen and likewise cause hypoxia.
3. **Particulate Matter:** Exposure to particulate matter has been associated with heart attacks.
4. **Increased Heart Rates and Physical Exertion:** The fight or flight response that a firefighter experiences every time he responds to an emergency call causes a sympathetic nervous system response which increases heart rate. In addition, the sedentary periods followed by heavy physical exertion, places the firefighter at risk for a heart attack.
5. **Heat Stress:** Heat exposure causes loss of fluids and can lead to arrhythmias, conduction abnormalities, and myocardial ischemia.
6. **Noise Exposure:** Firefighters noise exposure can exceed 120 decibels which can lead to hypertension.
7. **Shift Work and Overtime:** The literature supports that long hours can increase blood pressure.
8. **Environmental Tobacco Smoke:** Not all fire stations are smoke free, this exposes firefighters to second hand smoke.

This publication goes on to define organizations such as the National Fire Protection Association (NFPA) and the National Fallen Firefighter Foundation (NFFF). Five case reports of on duty deaths are presented to further describe the seriousness of cardiovascular disease among firefighters.

NIOSH defined the following factors involved with on-duty sudden cardiac deaths:

- Inadequate medical evaluations of candidates.
- Insufficient work restrictions following the identification of specific medical conditions.
- Absence of, or nonparticipation in, an adequate fitness or wellness program.
- Delayed access to or inadequate training on AED (automatic external defibrillators).
- The sudden death while driving to respond to an emergency.

The publication concludes by describing recommendations for candidates and fire stations. The recommendations include comprehensive wellness/fitness programs, medical clearance with annual exams, and use of respiratory protection during all phases of firefighting.

This is a very good summary of all of the risk factors involved in firefighting along with recommendations to prevent sudden cardiac deaths. It is a great reference tool that highlights all of the issues involving firefighter's health risks. I included many of the highlights of the article for my future reference in my work project.

9. Gledhill N, Jamnik VK. Characterization of the physical demands of firefighting. *Can J Spt Sci.* 1992;17:207-213.

This article describes the physical demands involved in firefighting. It reviews the literature, describes testing for physical capacity, and delineates specific task demands involved in firefighting. Weights of equipment and forces used in the job were measured. Heart rate and VO_2 were measured performing specific operations. The subjects were experienced firefighters with an average of 5.4 ± 2.8 years of experience and a mean age of 30.4 ± 3.5 years. A summary of the results are as follows:

1. The most physically demanding tasks are:
   - Carrying equipment up stairs in a high rise
   - Advancing charged hoses
   - Breaking down doors, walls, ceilings, and roofs
   - Raising ladders
   - Working overhead with a pike pole or other equipment
   - Rescuing victims
   - Raising and lowering equipment from high rise windows via ropes
   - Auto extractions
   - Carrying equipment long distances from the truck to a fire site

2. Common weights of equipment:
   - Protective clothing and Self Contained Breathing Apparatus (SCBA) = 48.4 pounds
   - Air cylinder high rise pack (two cylinders in a sling) = 36 pounds
   - CO_2 extinguisher= 40 pounds
   - 20 foot 1 person ladder= 56 pounds
   - 35 foot 2 person ladder= 135 pounds
   - Hurst Bacco spreader (extrication) 72.7 pounds

3. Common forces for tasks:
   - Hoisting 2 ½ " hose using a hose roller = 80 pounds
   - Lowering 143 pound victim using a rescue hitch=111pounds
   - Advancing hose- two 50' sections of uncharged 2 ½ " hose and nozzle= 114 pounds
   - Advancing hose- two 50' sections of charged 2 ½ " hose and nozzle= 150 pounds
   - Raising 35' extension ladder= 95 pounds

4. Heart rate and VO_2 while performing a representative sample of physically demanding firefighter operations:
   - Carrying equipment up stairs in a high rise
     - Highrise pack plus halligan tool= duration 128 sec HR :163 bpm VO_2=44 ml/kg-min
   - Advancing charged hoses
     - 50' of dry 2-1/2 hose and nozzle= duration: 21 sec, HR: 146, VO_2: 23.4 ml/kg-min
   - Breaking down doors, walls, ceilings, and roofs
     - Forcible entry= duration: 46 sec, HR 164 bpm, VO_2 30.5 ml/kg-min
   - Raising ladders
     - Set-up 50' Bangor: Duration: 133 sec, HR 139 bpm, VO_2 18.3 ml/kg-min
   - Working overhead with a pike pole or other equipment
     - Duration: 39 sec, HR 161 VO_2 23.6 ml/kg-min
   - Rescuing victims
     - Victim carry 143 pounds Duration: 17 sec, HR 152, VO_2 17.5 ml/kg-min
     - Victim Drag 200 pounds Duration: 25 sec HR 148, VO_2 20 ml/kg-min
   - Raising and lowering equipment from highrise windows via ropes
     - Lowering 143 pound victim with rescue hitch: Duration 103 sec, HR 144 bpm, VO_2: 23.2 ml/kg-min
   - Auto extractions:
     - First response kit: Duration: 26 sec, HR 161, VO_2: 20.4
   - Carrying equipment long distances from the truck to a fire site
     - Water backpack: Duration 27 sec, HR 134 bpm, VO_2 9.7 ml/kg-min

Overall VO_2 max that is necessary for a firefighter to perform the job functions was determined to be 45 ml/kg-min.

This study quantifies the essential tasks that a firefighter performs. The usefulness of the data includes fitness for duty evaluations and fitness programs. This article is extremely beneficial for summarizing the tasks involved in firefighter and quantifying the firefighter's job. It has made me think about the many pre-placement exams that we do at work and how we could modify them to include testing specific strength items. This information will be used when developing a specific strength training program for this case study and the future project I'm involved in with the Lisbon Fire Department.

10. Kales SN, Aldrich J, Polyhronopoulos G, et al. Fitness for duty evaluations in hazardous materials firefighters. *JOEM.* 1998;40:925-931.

This study analyzed the medical examinations of 340 hazardous materials firefighters to establish what the best criteria would be to determine fitness for duty. The subjects

were from 6 Massachusetts HAZMAT teams. The examinations were done at 3 different hospitals. There were multiple sources for the criteria which included input from Occupational Medicine Physicians, the National Fire Protection Association (NFPA revision 1582) and guidelines determined by the investigators and examiners. The exclusion criteria included:

1. Blood Pressure: Resting Systolic Blood Pressure greater than 179 or resting diastolic greater than 99 (source NFPA revision 1582)
2. Resting diastolic blood pressure greater than 109, post exertion systolic greater than 219 and diastolic greater than 109 (Medical workshop)
3. or resting diastolic blood pressure greater than 104

The results showed that 97% or 331 firefighters were determined to be fit for duty. The 9 firefighters (3%) who were judged unfit for duty were all examined at one particular hospital. The reason for the unfit classification for 7 of the 9 was because of high resting blood pressure or postmini-fitness blood pressure values.

This study sought out why it is important to have uniform standards for fitness for duty since different criteria will yield different results. This is important information as related to consistency in fitness for duty evaluations for firefighters. The blood pressure guidelines are particularly useful for me as we perform pre-placement exams at work with workers that have pre-existing blood pressure problems.

11. Kales SN, Soteriadesm E, Christohi C, Christiani D. Emergency duties and deaths from heart disease among firefighters in the United States. *New Engl J Med.* 2007;356:1207-1263.

The authors studied data from the reported deaths from firefighting using two reviewers and a third reviewer when necessary to resolve disputes. The reviewers read narrative reports of 1144 firefighter deaths from 1994 to 2004 and classified the deaths of firefighters as cardiovascular or noncardiovascular.

The authors made the initial assumption that if the firefighters spend x% amount of time in a particular task, then deaths related to that task would equal x%. The top 3 activities were fire suppression (32.1%), alarm return (17.4%), and fire station and other non-emergency duties (15.4%). Some limitations of the study include that the estimates of odds ratios do not apply the same to volunteer firefighters, lack of autopsy data, and the initial assumption that the number of deaths is directly related to the amount of time spent performing that duty.

This study further helps to define the tasks that are physically demanding for a firefighter. By knowing these specific tasks, improvements can be made in specificity training for those demands and testing firefighters to ensure their ability to perform those tasks.

12. Kales SN, Soteriadesm E, Christohi, C, Christiani, D. Firefighters and on-duty deaths from coronary heart disease a control study. *Environ Health.* 2003;2:14.

This study was done to determine occupational and personal risk factors associated with coronary heart disease among firefighters since 45% of on-duty deaths are related to coronary heart disease. This is about 1000 deaths per year. The authors examined 310 Massachusetts firefighters. They concluded that that most of the on duty cardiac deaths are because the firefighters have cardiac risk factors. They suggest improved fitness promotion and medical screening to prevent these deaths.

These study results are compatible with previous study results of cardiac deaths among firefighters. It is important information to help prevent the deaths of firefighters from cardiac events.

13. Peate WF, Lundergan L, Johnson J. Fitness self-perception and VO2 max in firefighters. *J Occup Environ Med.* 2002;44:546-550.

This was a study of 101 firefighters who completed a questionnaire asking them to rank their fitness level from 0 to 7 (0 being low fitness and 7 high). VO_2 max was then measured using a 5-minute step test and a submaximal treadmill test. There was no association between the firefighter's self perception of fitness and VO_2 max results. The authors conclude that aerobic capacity of firefighters needs to be tested periodically. The authors believe that further studies need to investigate what exercise equipment is available at work or home, what are reasons for using or not using the equipment, how does management support fitness, and what are the benefits of provider-offered exercise prescription in work communities.

This was an interesting article since many cardiac related deaths from firefighters could be prevented with a proper exercise program and what some firefighters perceive as a good fitness level may not be enough when really tested.

14. Rhyan S. Improving fatigue resistance for a firefighter physical ability test. *Strength and Conditioning J.* Lawrence: 2006;28:60-68.

This article describes the PAT (Physical Ability Test) that a firefighter must pass before entering the fire academy. The PAT consists of a series of anaerobic activities of 15 to 60 seconds in lengths that simulate firefighting activities. The PAT is completed with gear including a 30 pound breathing apparatus. The author describes how to train properly for a PAT (and ultimately to be a firefighter). His suggestions include: aerobic conditioning. Anaerobic high-power heavy workloads, neuromuscular development including lifting 30-50% of 1RM, 5-10 repetitions with fast movement for 3-5 sets. The author mentions training specifically for speed of movement, skill requirements, and biomechanical tasks.

I will use these recommendations with the initial strength program for this case study.

OTHER RESOURCES:

1. www.webmd.com – Firefighter Killer: Heart Disease Heart Disease Is Firefighters' Biggest On-Duty Death Risk By Daniel J. DeNoon – WebMD Medical News Reviewed by Louise Chang, MD
2. www.nfpa.org – Many firefighters with known heart problems go to work. Health promotion, screening could help prevent cardiac arrest – the top killer May 16, 2005
3. NFPA 1583 Standard on Health-Related Fitness Programs for Firefighters 2000 Edition
4. http://www.cher.ubc.ca/HeartDisease.htm
5. http://www.bls.gov/opub/ted/1999/jul/wk1/art04.htm
6. http://www.bls.gov/opub/cwc/archive/summer1999art1.pdf
7. http://www.fitnessage.com – the fitness assessment we used
8. www.the-hero.org/newsletter.htm
9. http://firefightersworkout.com/mentor.html – interesting workouts for firefighters
10. Health and Wellness Guide for the Volunteer Fire Service
11. FA-267/January 2004. FEMA publication – overview of a wellness program for firefighters
12. Franklin, BA (Sr. Ed.). ACSM's Guidelines for Exercise Testing and Prescription, 7th ed., 2006. Lippincott Williams & Wilkins, ISBN 0-7817-4506-3.

KEY INFORMATION FOR DESIGNING A FITNESS PROGRAM FOR A FIREFIGHTER FROM THE READINGS

The following summarizes the information in the readings as it pertains to an exercise prescription:

1. **The firefighter must be able to work at 45 ml/kg-min or 13 METs.**[1,2]
   a. Aerobic exercise will be imperative. Recommend elliptical, bike, treadmill, track, etc.

2. **The firefighter frequently gets called to do heavy work following a sedentary period.**[1,3,6]
   a. Recommend training with anaerobic bursts such as windsprints for running and adding short intense periods to the workout.

3. **The firefighter must be able to withstand heat.**[1]
   a. Instruction in proper hydration is crucial to preventing dehydration.

4. **The firefighter must be able to perform the following strength tasks:**

   a. Hoisting 2 ½ " hose using a hose roller= 80 pounds.[2]

   b. Upper body strengthening including pectorals and posterior shoulder, rotator cuff strengthening.

   c. Lowering 143 pound victim using a rescue hitch = 111 pounds.[2]

   d. Squats, leg presses, trunk and core strengthening will help with this activity.

   e. Advancing hose- two 50' sections of uncharged 2 ½ " hose and nozzle = 114 pounds.[2]

   f. Upper body strengthening including pectorals and posterior shoulder, rotator cuff strengthening.

   g. Advancing hose- two 50' sections of charged 2 ½ " hose and nozzle = 150 pounds.[2]

   h. Upper body strengthening including pectorals and posterior shoulder, rotator cuff strengthening.

   i. Raising 35' extension ladder = 95 pounds.

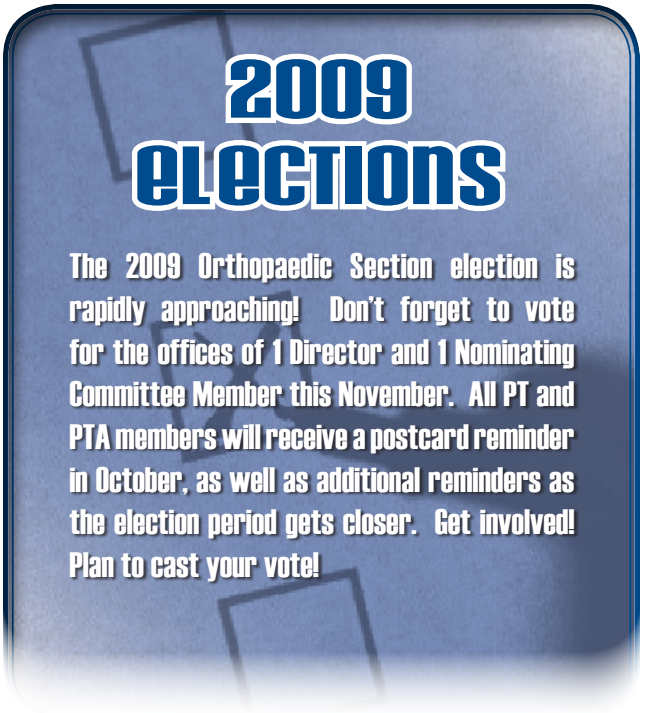
   j. Upper body strengthening including pectorals and posterior shoulder, rotator cuff strengthening.

   k. Rescuing victims.[2]
      - Victim carry 143 pounds Duration 17 sec
      - Victim Drag 200 pounds Duration: 25 sec

   l. Practice carrying progressive weights and dragging weights.

   m. Resisted walking with weights.

Additional recommendations: Anaerobic high-power heavy workloads, neuromuscular development including lifting 30% to 50% of 1RM, 5-10 repetitions with fast movement for 3-5 sets. The author (Rhyan et al) mentions training specifically for speed of movement, skill requirements, and biomechanical tasks to prepare for the PAT (Physical Ability Test) that a firefighter must pass before entering the fire academy.[6]



PRESIDENTS MESSAGE

John Garizione, PT, DPT, DAAPM

FIBROMYALGIA AND THE CENTRAL NERVOUS SYSTEM

When I saw my first fibromyalgia (FM) patient in the late 1970s, there was a paucity of literature to guide the treatment plan. Initially called "fibrositis," the thinking at that time, was that the disorder was inflammatory and confined to "lazy, neurotic females." Treatments were limited to nonsteroidal and steroidal anti-inflammatory agents, analgesics, local heating modalities, and strengthening exercises. Interestingly, when men also reported widespread pain, sleep disorders, memory deficits, etc. the term Fibromyalgia with diagnostic criterion was published.

Over the years, there has been an increased body of knowledge about the causes, effects, and treatments of FM. Acute or repetitive muscle injury has been associated with FM pain that produces widespread central sensitization from augmented pain processing of the peripheral nociceptive signals. Staud postulated that glial activation by cytokines and excitatory amino acids play a role in the initiation and continuation of this central sensitive state.[1] Fibromyalgia patients are found to have greater sensitivity to auditory, thermal, and pressure stimuli as well as temporal summation of pain, known as "wind up and wind up after- sensations." Clinical intensity of FM can be predicted by the combination of the amount of wind up after-sensation, tender point count, and negative affect.[2]

When FM patients held 30% of maximal voluntary isometric contraction of handgrip for 90 seconds, they developed increased hyperalgesia in both local and remote areas compared to normal controls that developed hypoalgesia of both local and remote areas. This indicates an altered central pain mechanism that FM patients have which may be from either abnormal descending inhabitation or excessive activation of muscle nociceptive afferents.[3]

Along the same lines, and as an answer to OP Editor Christopher Hughes's call for student papers, this issue's topic was written by an Ithaca College student who I had the pleasure of having in my clinic this summer.

The next project that the PMSIG will undertake will be a practice analysis of the pain management physical therapist. All thoughts on this matter will be greatly appreciated and can be sent to johngarzione@frontiernet.net.

Enjoy the fall and Happy Thanksgiving. - John

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DIET AND EXERCISE FOR PAIN MANAGEMENT OF FIBROMYALGIA

Shanna Andrews, Student PT, Ithaca College

Fibromyalgia (FM) is a syndrome that has sparked the curiosity of pathologists, physicians, physical therapists, psychologists, and other professionals alike. In 1990, the American College of Rheumatology determined a specific set of symptoms/criteria for the diagnosis of FM symptoms including a widespread musculoskeletal pain for a minimum duration of 3 months in all 4 limbs and the trunk. Also required for diagnosis is tenderness to palpation of 11 out of 18 specified tender points. In addition to the above mentioned symptoms, patients commonly experience poor-quality sleep, morning stiffness, cognitive difficulties, psychological stress, fatigue, and depression. Approximately 2% of the US population suffers from a form of FM with the majority being females between the ages of 40 and 50 years old.[1]

There are 3 different types of FM known as primary, secondary, and posttraumatic FM. Primary FM occurs with an insidious onset, secondary FM occurs as the result of an infectious disease or rheumatoid disorder, and posttraumatic FM can be linked to a past traumatic experience.[2]

The specific cause of FM is not completely known and there is no absolute cure. Many medications have been found to target the most common symptoms of FM. Although designed to diminish certain symptoms, these medications can produce adverse side-effects such as dizziness, sleepiness (Lyrica), headaches (Ambien), dry mouth, constipation (Flexeril), blurred vision, and trouble sleeping (Effexor) just to name a few.[3]

In contrast, there are nonpharmacological remedies that can reduce symptoms without causing unnecessary side-effects. Diet and exercise are 2 of these remedies that can have positive effects on individuals who have FM.

The critical issue surrounding exercise in FM is the type of exercise that will produce positive results. Quite often, people who have FM are afraid to move and especially to participate in cardiovascular exercise routines. Richards and Scott[4] found that after a 12-week program of stretching and relaxation or a program focusing on cardiovascular activities, the individuals in the cardiovascular group showed more improvements in their overall symptoms. Many participants had fewer tender points (which in some cases lasted as long as 12 months) and had decreased scores on the FM impact questionnaire which indicates a decrease in symptoms and disability.

Aquatic exercise becomes an option for FM patients when there is access to a pool. Both stretching and cardiovascular activities can be combined in an aquatic program. After involvement in a pool-based exercise program for 20 weeks, FM patients experienced the same amount of decreased pain, daytime fatigue, stiffness, anxiety, and depression as people who participated in a land-based program.[5]

In many of the studies that look at exercise, participants exercise in a group. Some researchers hypothesize that the improvements that the participants show may be the result of the group atmosphere in addition to the exercise itself.[6] The group or exercise class may also play the role of a built-in support system.

As for the effect of diet, Kaartinen et al[7] found that when individuals with FM were put on a vegan diet consisting of cereals, legumes, berries, vegetables, mushrooms, nuts, and seeds for 3 months, they experienced a reduction of pain at rest. These individuals also reported less morning stiffness and an improvement in their overall quality of sleep. Other healthy benefits of the vegan diet included a reduction in the body mass index (BMI) and the lowering of LDL (low density lipoprotein).[7]

For some, a nonpharmacological approach to treating FM includes the addition of certain supplements to a normal diet. Although these dietary supplements have evidence to support their effectiveness, some people may believe that this particular route for treatment is still pharmacological. Common supplements used include magnesium, malic acid, melatonin, S-adenosylmethionin (SAMe), and 5-hydroxy-tryptophan (5-HTP). 5-HTP helps to increase brain levels of serotonin which have been found to be relatively low in many cases of FM. S-adenosylmethionin also helps to increase the levels of serotonin and other neurotransmitters. Both of these substances individually may lead to a reduction of certain symptoms including depression and various body pains. The addition of melatonin to a normal diet, which is often low in individuals with FM, has been linked to improved quality of sleep and to a reduction in the number of tender points. Fibromyalgia sufferers who use a combination of magnesium and malic acid have reported that they experience less muscle tension.[8]

Although certain types of exercise and nutrition have been found to decrease the overall symptoms of FM, there is still more research that needs to be done regarding these topics. If unnecessary side-effects can be avoided, then a nonpharmacological route would be the preferred treatment. When used in the combination, exercise and diet may be effective for the treatment of FM.

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PRESIDENT'S LETTER FALL 2008

Fall Greetings! As the days get shorter, the work the PASIG is doing for you remains long. We have a dedicated board that is working to provide services to YOU, the members. Please do not hesitate to contact us with performing arts related questions. Please visit our website, which you can link to from www.orthopt.org.

This fall, be looking for a membership survey in your email that the PASIG will use to update our membership directory. If you do not receive the monthly email citation blasts from the PASIG, please contact Julie O'Connell, our Membership Chairperson, and she will make sure you are added to the list.

The PASIG board is planning to hold a retreat in January 2009 to establish some action items for the next 3 to 5 years. We will be looking for people to help on committees and projects, so please consider volunteering.

The Education Committee, headed by Tara Jo Manal, is working to bring you excellent programming at CSM 2009 in Las Vegas. The topic for the PASIG educational sessions will be the Foot & Ankle. If you are planning on attending or considering it, see the line up in this newsletter for more information.

Congratulations to our USA gymnasts for their excellent performance at the 2008 Olympics in Beijing, China! As a caveat to the Olympics, this PASIG newsletter is highlighting a gymnastics case report by Gina Pongetti, MPT, MA, CSCS, ART-Cert. Gina has the opportunity to work with elite level gymnasts, and has contributed to the "Flip into Action" series in the introduction to our monthly email citations blasts.

An exciting first is happening for the APTA's consumer publication, "For Your Health." The cover of the 2008 issue that is released in October features two women - popular electric violinist, Caryn Lin, and her physical therapist. Please be sure to share this magazine with your patients and referral sources!"

Hope to see you at CSM in Las Vegas.
Until then, yours in the arts,

Leigh A. Roberts, PT, DPT, OCS

A GYMNAST'S LOW BACK PAIN RESPONDS TO SHOULDER AND HIP STRETCHING

Gina M. Pongetti, MPT, MA, CSCS
Jennifer Skaling, PT
Tara Jo Manal PT, DPT, OCS, SCS

Injury rates in gymnasts range between 25% and 56% and increase if the athlete participates in more than 15 hours per week of training.[1] The specific incidence of low back pain among these rates is unknown, however, degenerative spinal changes are found in as many as 63% of female Olympic level gymnasts.[2] Many factors have been implicated in gymnasts back pain including spinal muscle weakness,[3-5] traumatic hyperextension injuries,[5,6] decreased flexibility and weakness of the hip musculature,[3,4,7] and mechanical stresses of the spine.[8] The demands of the sport including long practice hours, skill repetition to perfection, and extreme flexibility encourage gymnasts to expect and often "push through" pain complaints. Gymnasts have expected pain levels that may contribute to delays in seeking evaluation or treatment for spinal pain.

The mechanics and kinesiology of the sport of gymnastics contribute to the efficiency and accuracy of the skills performed. Gymnastic skills can be deconstructed to reveal the required individual joint and muscle range of motion necessary for skill completion. Dividing the body into the 3 regions--upper extremity, trunk, and lower extremity--provides an insight into areas of excessive or limited motion. Further analysis of the contributing motion segments within each of these regions can provide the therapist target areas for mobilization or stabilization as appropriate. In theory, body segment mobility can influence the function and stress of the joints above and below the painful area. Relationships between the lumbar spine and thoracic region,[9] and the pelvis and sacral-iliac region have been implicated in spinal dysfunction.[3,5] Shoulder motion has also been linked to thoracic spine motion through the interconnected scapular musculature.[9] The ideal relationship between the mobility of the shoulder, spine, and hip necessary to avoid back injury in gymnasts has not been elucidated.

Positions achieved in gymnastics comprise multiple joints, often in end ranges, in both weight bearing and nonweight bearing positions. Glenohumeral range of motion is very important in the sport of gymnastics where athletes perform shoulder flexion beyond the typical 180° position. In floor performance, the upper extremity is flexed in an open-chained position while in back tumbling skills the excessive positions are weight-bearing. Static stretching positions, such as the backbend, walkover, back handspring (Figure 1) and other progressions demand prolonged positioning in extreme

shoulder motion. Weight bearing and high forces occur in the moments before the release and recapture of the bar on uneven bars or high bar (Tkatchev's or Jaegers) and dismounts such as toe fronts. These skills although shoulder intensive, also involve coordinating spinal arching with or without lumbar lordosis.

Gymnasts also perform hip extension past neutral, with our without a rotated lumbar spine (Figure 2 and 3). Gymnastics and dance skills often contain a form of arching, with (1) lower extremity extension alone with a neutral lumbar spine (ex: leaps, front tumbling skills,), (2) lower extremity extension combined with upper extremity extension (ex: arabesque, Pak Salto (Figure 4) on Uneven bars, back walkover), (3) gravity assisted high velocity arching involving a combination of upper, lower extremity, and the lumbar spine (ex: Tkatchev release move, Yerchenko vault), or (4) arching of the spine (lordosing) for artistic composition but not for the completion of a skill (dance or tumbling skills on floor exercise, artistic and rhythmic) (Figure 5) .

Therapist analysis of motions and the quality of skill performance can provide insights into regions that may benefit from interventions. The handstand is a base gymnastic skill combining shoulder range (180°of glenohumeral) and scapulothoracic motion with hip extension to neutral on a stable neutral spine (Figure 6). When a gymnast has a deficit in any of the contributions to this composite position, another area must compensate to achieve the desired position (Figure 7). The compensation results in a technically faulty handstand lacking neutral shoulder flexion and increasing hip extension and spinal lordosis. Deficits in the coordination among the shoulder, spine, and hip will impact the biomechanics of the handstand and will also impact the many skills that are expansions of this position such as the cast handstand on bars, free hip handstand, giant swings on bars, back handspring on floor, Yerchenko-style vaults, forward and back walkovers, and more.

The following case study will demonstrate how stretching of the hip and shoulder decreased the gymnast's subjective complaints of back pain during daily and gymnastics activity. The subject is a 14-year-old level 10 USA Gymnastics Junior Olympic (J.O.) gymnast with a 2-year history of low back pain (school sitting and gymnastic participation). In the past 6 months, she complained of decreased flexibility in spinal arching. Her previous physical therapy included massage and electrical stimulation of her paraspinals, static spinal stretching into extension, prone lumbar posterior-anterior joint mobilizations, and a variety of dynamic abdominal exercises. On the initial evaluation the patient complained of generalized low back pain centered in the L2-L5 region,

Figure 1.
Example of a backbend on the balance beam activity, portraying the extreme hip and lumbar ROM requirements of this sport.

Figure 2.
Example of a split leap in the ring position with external rotation of the hip. This skill requires hip extension ROM beyond neutral.

Figure 3.
Example of a sheep jump, demonstrating the need for simultaneous hip and lumbar extension.

Figure 4.
Example of a Pak Salto on uneven bars. This skill requires upper extremity, lower extremity, and lumbar extension in combination.

Figure 5.
Example of a skill that requires extreme lordosis for artistic composition.

Figure 6.
Example of a correctly executed handstand, showing the combination of 180° of glenohumeral and scapulothoracic motion, hip extension to neutral, and a stable neutral spine position.

Figure 7.
Example of an incorrectly executed handstand, showing decreased shoulder flexion, excess hip extension, and excess lordosis.

Figure 8.
Proper patient position for the measurement of glenohumeral flexion ROM.

Figure 9.
Compensated patient position for glenohumeral flexion ROM measurement, creating inaccurate measures.

Figure 10.

Example of hinging of the spine; no lordosis is evident above and below the hinged segment.

Figure 11.

Example of hinging of the spine; no lordosis is evident above and below the hinged segment.

Based on the findings, we hypothesized that the reduced range seen in the shoulder and hip were causing increased stress on specific segments of the already hypermobile lumbar spine. The goal of the treatment plan was to increase mobility at the proximal (shoulder) and distal (hip) end of the trunk to determine if range gains here and education on controlling excessive spinal motion could alleviate pain and improve function. We hypothesized that with proper rehabilitation and tactile and verbal reeducation, the patient may be able to control excessive spinal motion and use gained hip and shoulder motion to reduce spinal compensations and stress.

The patient was treated twice weekly for approximately 45 minutes with a 4-part approach; stretching, postural training, deep tissue massage, and resistive exercises. Active and passive bilateral shoulder flexion stretching was performed in the clinic while blocking the rib cage from posterior tilting. The patient's knees were bent in supine to reduce lumbar lordosis

Table 1. Gymnast Data and Outcomes

	Pain Worst : Best	Oswestry[7]	Roland Morris[10]	Hip Extension ROM		Shoulder Flexion ROM		Shoulder external Rotation ROM		Shoulder Internal Rotation ROM	
				Left	Right	Left	Right	Left	Right	Left	Right
Initial Evaluation	8/10 : 2/10	53.33%	8/24	Hyper 3°	7°	141°	144°	51°	54°	39°	41°
8th Session (32 Days)	---	---	---	10°	6°	161°	160°	68°	71°	50°	52°
Discharge (92 Days)	1/10 : 0/10	86.66%	1/24 (87.5% Improvement)	23°	19°	183°	181°	78°	78°	59°	59°

with no radiating symptoms, and no isolated spinous process pain with palpation. Her pain scores and questionnaire results are found in Table 1. Initial evaluation of the athlete included hip extension range of motion in sidelying with the opposite leg in hip and knee flexion. Measurements were taken with the knee in extension to decrease the compensation of two joint hip muscles while avoiding a spinal lordosis compensation. Measurements are found in Table 1. Shoulder ROM measurements were measured for shoulder flexion, internal rotation (IR), and external rotation (ER). Measurements of the shoulder range of motion were performed supine while manually controlling for a thoracic compensation. The thoracic spine was stabilized supine on the table and the examiner did not allow the athlete to flex or extend the thoracic spine. The gymnast actively extended the elbow during the measurement to simulate sport-specific positions. Verbal cues and tactile cues provided feedback on rib tilting, spine lordosis, and elbow bending compensations (Figure 8 shows proper measurement, Figure 9 shows compensations in measurement). Measurements are in Table 1.

Visual examination of standing lordosis was completed. The athlete was instructed to "arch" the back (Figure 10) and flex the spine "while standing, round your back forward as much as possible, from neck to tailbone" (Figure 11). Posterior to anterior (PA) prone-positioned segmental manual joint mobility assessment was performed. The results were hypermobility at T12/L1, L1/L2, and L4/L5 and hypomobility at T7-T12, L2/L3, and L3/L4.

and abdominal contractions were added to flatten the spine if lordosis began. The progression began in supine and progressed to supported standing against a wall ending with free standing when tolerated. Passive stretching of shoulder internal and external range was performed clinically and followed up with a home stretching program daily. Sport specific postural training was implemented to maintain neutral joint positions with activity. The athlete performed repetitive standing hip extension through small ranges, with verbal cues to avoid femoral external rotation and/or spinal movement beyond neutral. Standing arching was performed with tactile cues to encourage equal segmental contributions to the motion.

Deep tissue massage techniques were used to loosen the muscles surrounding the shoulder and hip. Active Release Techniques (ART) is a hands-on manual therapy technique purported to break up inter- and intra-muscular scar tissue, release fascia, increased localized blood flow, and restore motion. The anterior hip joint and thigh were treated with techniques described to release areas such as psoas, iliacus, lateral femoral cutaneous nerve, distal rectus abdominus attachment, pectinius, gracilis, sartorious, rectus femoris, intertransversarii, and adductor magnus. The axillary region was also treated to include intercostal (anterior and lateral), subscapular area, and humero-thoracic areas in an attempt to increase rib expansion, shoulder flexion, and decrease scapular abduction and external rotation. The only treatment directed at the lumbar spine was effleurage massage for pain reduction and increased blood flow once weekly prior to physical therapy.

Table 2. Gymnastic Progressions by Level

Level	Activity					Conditioning
	Vault	Bars	Beam	Tumble Track	Floor	
5	Run- 2 min each - Front - Left - Right - Back Board to Vault 1/2 Handstand Bounces	Kip Casts to 45° Tap Swings High Bar	Leaps Jumps Cartwheel Turns	Roundoff Back-handspring x15 2 Consecutive standing Back-handsprings x15	Roundoff Rebound x30	Provided HEP Hollow Holds Hanging Bar Single leg split lifts Tuck up Pull-ups
6	Front Handsprings on Resi from board x15 Running Drills	Hand Kip Casts Giants on strap bar Front Back Floor Bar Pirouette	Standing Back-handspring Step Out on low beam	Back Tumbling to Layouts Release Front Handspring 2-foot Singles x 15	Corner Sprints 3 Row x 10 Standing Back Tucks x 15 Front Hand Step Outs Roundoff Back-handspring x 10	Standing Back Tucks from 4-6 feet in air Tumble Vault Full Hang Bar
7	Yerchenko Entry Timers Board to Resi Pit Running Front Handsprings x10	Free Hip to Hand Giants on Set Bars Kip Cast to 135°; 3x6 in a row	Backhandspring on high Step Out x15 Roundoff Dismount	• Back Tumble Release • Front Tumble to Bounding	Roundoff Back-handspring; 5x5 in a row Roundoff Back-handspring Tuck x5 Front Hand Tucks x10	Hollow Hold Progression Blood Pressure Cuff Sahrman Program
8	Yerchenko to vault x10 25 Drill to Resi	Swinging Jaeger/Tkatchev Timers x5	Back-handspring series high x15 Standing Back Tucks Side Sumi Roundoff Dismount Drills Flip High Resi	Full Release	Roundoff Back-handspring Lay x10 Fulls from Air Mat Front Hand Lay x10	Same as Level 7
9	Full Yerchenko Flip x10	High to Low release Bail Free Hip; 5x3	Layout Series Release Low beam x15 High x5 Return High Front Tucks x10	Full Release	Front Hand Lay to Tuck x5 Full Back Tumble Release Hard Floor to Fulls	Case Specific
10	Full Yerchenko Release	Full Release Dismounts Double Back	Full Release 50% Back-Handspring Lay Series	Full Release	Full Release on Floor	Case Specific

Theraband and cuff weights on the distal extremity (appropriately wrist or ankle) were used for strengthening for the hip extensors and the shoulder extensors. The strengthening was performed through full range of motion including the ranges immediately made available after the stretching component of the therapy. The goal of working in the end range was to allow the body to strengthen through this newly obtained arc of motion.

After the 8th session a re-evaluation was performed (see Table 1). After her 10th session, she was released to perform weight bearing gymnastics at the level of USA Gymnastics J.O Level 5 athlete, with the progression of one level of equivalent difficulty every 2 practices (See Table 2). She was also limited to 50% repetition of elements and routines. After 7 weeks, the patient was released to perform full gymnastics, continuing a home program for 3 months following return to sport. The home program consisted of 6 stretches for 45 second each, performed twice daily after instruction in the clinic with tactile, verbal, and visual feedback. For the pelvis the athlete performed the Thomas stretch, a half kneeling stretch with a concentration on posterior rotation of the pelvis to further stretch the hip flexors, and a supine knee flexion stretch pulling the heel to the buttock avoiding hip IR or ER with a posteriorly tilted pelvis. Upper extremity stretching included the doorway pec stretch and a supine shoulder flexion with a weighted bar, avoiding spinal movement. Lastly, the patient was to perform a variation of the back bend/bridge, with the athlete holding overhead on to a partner's ankles while laying on floor before beginning the stretch. The partner used manual pressure on the proximal humerus to open the axillary region without straining the lumbar spine or allowing the athlete to bend the elbows or knees. At discharge, 92 days after initial evaluation she improved in range of motion, pain rating, and questionnaire data (See Table 1).

Decreased flexibility of the shoulder and the hip may contribute to increased pain in a gymnast with lumbar hypermobility and low back pain. Increases in shoulder and hip range coupled with postural training during sport specific activities, endrange resistive exercise and soft tissue work assisted the athlete in reducing pain and functional disability ratings and ultimately pain-free return to sport participation. Evaluation and treatment of joints above and below a site of injury are essential to a comprehensive evaluation of all patients, however, understanding that these motions may need to exceed typical normative values can be paramount in athletics.

Future research on gymnasts may provide data on range of motion needed in the shoulder and hip joints to reduce or prevent low back pain. The rehabilitation specialists managing

athletic low back pain will benefit from this information to ensure comprehensive restoration of sport specific motions and identify deficits that may increase gymnasts risk for low back pain. With our treatment of performing artists, including gymnasts, dancers, and figure skaters, we find these measurements and flexibility training are a useful component of low back treatment.

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APTA Performing Arts Special Interest Group

CSM 2009- Las Vegas

Thursday, February 12th, 2009

8:00 AM - 8:40 AM
Evaluation of the foot and ankle in performing artists- Measurement reliability and Ability Measures
RobRoy L. Martin, Ph.D., PT, CSCS

8:40 AM - 9:00 AM
Clinical Case- The Influence of Boots in Figure Skating
Eric Greenberg, PT, DPT

9:00 AM - 9:40 AM
Rehabilitation and Manual Therapy for the foot and ankle of Performing Artists
The Kleven Institute

9:40 AM - 10:40 AM
Clinical Cases- Flexor Hallicus Longus tendonitis, MTP plantar plate tear, Sesmoid Fx, Cuboid Subluxation and Laceration and Repair of Extensor Hallicus Longus and Brevis
Sheyi Ojofeitimi, MPT and Shaw Bronner PT, PhD, OCS

10:40 AM - 11:00 AM
Clinical Case- Taping Procedures and Clinical Applications
Jason Tonley PT, DPT, OCS

animalrehabilitation

SPECIAL INTEREST GROUP

HELLO TO ALL OF OUR ANIMAL REHABILITATION SPECIAL INTEREST GROUP MEMBERS!

First, some thank you's…

…to Jennifer Brooks for coordinating efforts at the SIG booth at the 5th International Symposium on Rehabilitation & Physical Therapy in Veterinary Medicine in Minneapolis this August;

…to our members who worked as "booth babes" at the VetPT Symposium: Jennifer Brooks, Ellen Bloome, Alison Eagan, Jeanine Freeberg, Carrie Adrian, Katie Brusewitz, Donna Redman-Bentley, Beth Williams, Nancy Doyle, Michelle Lazarski, Lisa Bedenbaugh, Janet Steiss, and Connie Schulte;

…to our members who attended the VetPT Symposium and contributed to some lively discussion at the informal SIG business meeting at the conference; and

…to all of our members who responded to the AR-SIG Practice Analysis Survey (and those who helped to test the survey and serve on our national advisory group).

This coming year will certainly be an exciting one for the SIG. We've got a great educational session planned for CSM, "The Devine Equine," featuring Narelle Stubbs and Lin McGonagle. We'll be working on consolidating statistics and (finally) writing up the results of our Practice Analysis. We'll be launching our "pet project," the canine rehabilitation reference clipboard—thanks to Carrie Adrian and Tara Frederickson for their tireless efforts in revision after revision after revision.

Remember that the Canine and Equine Anatomy ISCs are still available through the Orthopaedic Section.

Nominations are open for A-SIG President. Please submit any nominations to Cheryl Riegger-Krugh (crieggerkrugh@gmail.com) or Amy Kramer (kramerpt@verizon.net), our nominating committee members.

As always, don't hesitate to contact me or the other officers of the SIG regarding any of your ideas for the future of the SIG, especially concerning continuing education opportunities for SIG members!

Till next time.
Amie Hesbach, PT
forpawsrehab@comcast.net

CORE CONCEPTS AND TRENDS IN ILIOPSOAS STRAINS

Caroline Adamson Adrian, MSPT, CCRP
Tamara Wolfe, BSPT, CCRP, GCFP

VCA Alameda East Veterinary Hospital, Denver, Colorado

Core stabilization is a developing concept in large and small animal physical therapy. A dynamic core stabilization program is an effective and important component of all comprehensive rehabilitation programs for the treatment of human low back pain. Trends in acute and chronic iliopsoas strain are revealing a remarkably high number of dogs presenting with spinal dysfunction and back pain. It is suggested that a dynamic core stabilization program, in addition to manual therapy, be incorporated in the treatment and prevention of canine iliopsoas strain with spinal dysfunction.

CORE STABILIZATION

The concept of core stabilization exercise may be defined as "the restoration or augmentation of the ability of the neuromuscular system to control and protect the spine from injury or reinjury." Most exercise programs for the treatment of spinal pain focus on strength, endurance, and fitness as well as functional capacity training. These more general programs are most appropriate in the late stages of rehabilitation to increase general muscular support of the spine and are of benefit to the deconditioned patient. More recent research suggests that a key impairment in those with low back pain is one of motor control rather than just a lack of strength alone. The aim of core stabilization is to control pain and protect and support the spinal segment[s] from reinjury. This is accomplished by re-establishing and improving muscle control to compensate for any loss of segmental stiffness in the spine caused by injury or degenerative changes.

Strategies of core stability exercise may be divided into 2 components: restore *control* and coordination of the trunk muscles to ultimately improve control of the lumbar spine and pelvis; and restore the *endurance and strength ('capacity')* of those trunk muscles to help meet the demands of control of the spine and pelvis.

The first approach, *control,* is dependent upon the central nervous system (CNS) which determines the requirements of stability in order to plan and implement certain strategies in which to meet capacity demands. It is the sensory system that provides information about status of stability where stability is challenged by predicted control of the spine through an internal or external force [eg, forces used to generate movement of a limb]. The sensory system must also provide information about stability status through unexpected perturbations where the CNS must initiate trunk muscle responses to maintain stability.

The second approach, *capacity,* is fueled by the well-established Euler model which states stability of the spine is dependent on the contribution of muscle. If the lumbar spine is devoid of muscle, buckling failure will occur with a compressive load as small as 90 Newtons. This model suggests that the activity of muscles spanning the lumbar spine help to stiffen the intervertebral joints and maintain the spine in a mechanically stable equilibrium.

Thus, the goal of core stabilization exercise is to improve postural control, ensure appropriate muscular balance and joint motions, allows for expression of dynamic functional strength and improved neuromuscular efficiency throughout the entire kinetic chain. Many of these canine muscles that are required for spinal stabilization include the multifidus, transverse abdominus, obliques, transversospinalis, erector spinae, gluteals, latissimus, longissimus, iliocostals, serratus dorsalis, rectus abdominus, and iliopsoas. The body's stabilization system must be functioning optimally to effectively use the strength, power, neuromuscular control, and muscular endurance that they have developed in their prime movers.

Structural changes due to disc disease, muscular changes such as poor endurance and weakness, or ineffective neuromotor control may all contribute to spinal instability and back pain. The biomechanics of those with nonspecific low back pain differ from those without back pain. Neuromuscular control combines postural alignment and stability strength to allow the body to decelerate gravity, ground reaction forces and momentum at the right joint, in the right plane of motion, at the right time. If this system is not efficient, it will be unable to respond to the demands placed on it during functional activities. As the efficiency of the neuromuscular system decreases, the ability of the kinetic chain to maintain appropriate forces and dynamic stabilization decreases significantly. Thus, if extremity muscles are strong and the core is weak, then there will not be enough force created to produce efficient movements. A weak core is a fundamental problem of inefficient movements that may lead to injury. An illustration of the potential for injury may be described in the diagram below.

Decreased neuromuscular efficiency
↓
Compensation and substitution patterns/ poor posture during functional activities
↓
Increased mechanical stress on tissues
↓
Repetitive microtrauma
↓
Abnormal biomechanics
↓
INJURY

ILIOPSOAS

This muscle, a fusion of the psoas major and the iliacus, originates on the transverse processes of the lumbar vertebrae 2 to 4 in addition to the ventral and lateral surfaces of lumbar vertebrae 4 to 7. The iliopsoas attaches to the lesser trochanter of the femur. Several articles as early as 1995 have reported traumatic injury to the iliopsoas muscle as evidenced by CT, MRI, and ultrasound.

The article by Fitch, Montgomery, and Jaffe continue to explore the detrimental effects of a muscle strain to include the process of inflammation and edema that will occur with acute trauma. The muscle contractile force is thus affected by a strain injury and normal histology is not restored. Scar tissue will persist in the muscle with the potential for repetitive trauma and continued tearing of the scar tissue if not treated. Prolonged immobilization will result in irregular muscle fiber patterns, further decreasing tensile strength as the muscle is replaced with fibrotic scar tissue.

Length of time of the iliopsoas strain also appears to determine outcome of treatment. Dogs with acute injuries of less than one month responded well to rest, restricted activity, and nonsteroidal anti-inflammatory medications. However, those dogs with clinical signs of greater than one month responded poorly.

TRENDS IN ILIOPSOAS STRAINS

In the past 8 months, data have been collected on dogs diagnosed with iliopsoas strain by 2 board certified surgeons. Trends in these data, documented by 2 physical therapists, include a limitation in active spinal and pelvic extension and rotation with functional activities. Moderate to severe muscle spasms have been evident in the lumbar musculature, and, in more severe chronic cases, have continued into the thoracic spine as far as the scapulae. In the areas of muscle spasms, decreased spinal motion in extension has been documented, in addition to a lack of spinal rotation and side bending. Pain, as verified by vocalization, pressure avoidance on palpation and muscle guarding (muscle spasm, tightness and sudden contraction along perispinal musculature) on dorsal palpation and rotation of spinal segments, has also been documented. These are possible correlations with what is seen clinically in dogs with iliopsoas strain, however, there are no current objective data to support these links.

As illustrated with the concepts outlined above, human physical therapy has recognized the relationship between weak core muscles causing decreased spinal stabilization that reduces structural support. In turn, this allows the musculature to be more prone to injury. Could there be a correlation between spinal dysfunction and iliopsoas strain in the dog? If so, where does the correlation lie? The challenge thus becomes pursuing the objective data necessary to prove or disprove these concepts of core weakness and their potential relationship to canine iliopsoas strains.

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THE ROLE OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION IN CANINE NEUROREHABILITATION

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Physical therapy and rehabilitation of the canine patient with a neurologic disorder is simultaneously both challenging and rewarding for the entire rehabilitation team, including the physical therapist, referring veterinarian, client, and patient. As with orthopaedic rehabilitation, the therapist creatively applies "human" rehabilitation strategies and techniques modified to the specific anatomy and physiology of the canine patient. Specific neurologic rehabilitation techniques employed by this therapist in the clinical setting include neurodevelopmental treatment (NDT), Rood-based facilitation techniques, and proprioceptive neuromuscular facilitation (PNF). All of these neurofacilitation techniques can be incorporated into treatments based on task-oriented or activity-based motor control theory, including functional electrical stimulation and body weight supported treadmill training, in order to more effectively and efficiently promote reintegration of the neuromuscular system.

Proprioceptive neuromuscular facilitation (PNF) is a method of manual treatment traditionally used by physical therapists for treatment of patients with neuromuscular and musculoskeletal disorders. PNF is much more than just functional, diagonal patterns of movement, but uses a philosophy and specific principles which are essential for promotion of normal patterns of, and improved quality of, movement.

The PNF philosophy, first described by Maggie Knott, a physical therapist at the Kaiser Foundation Rehabilitation Center, Vallejo, California, in 1948, includes a focus on a positive approach to treatment. All of the body movements, both of the therapist and of the patient, incorporated into the PNF patterns, have a specific, purposeful, and functional goal. PNF uses the stronger components of this functional movement or of the extremities to strengthen the weaker through irradiation and overflow.

Irradiation, a neurophysiologic principle described by Sherrington in 1947, is a spreading and increased strength of a response, which might be excitatory or inhibitory. Overflow, or afterdischarge, describes the theory that the effect of a stimulus continues after the stimulus stops. The strength and duration of the afterdischarge is directly related to the strength and duration of the stimulus.

A goal of PNF treatment is to tap the maximal response to effectively increase motor and sensory awareness. Repetition of this maximal response promotes motor learning. Additionally,

PNF is an intensive program with continuous activity. "Active rest" is an integral part of PNF treatment. In summary, the goal of PNF treatment is resultant optimal function with an integrated neuromuscular system.

The principles or procedures used during PNF treatment include consideration of: patient position, therapist position and body mechanics, the desired pattern of movement, manual contacts, the use of wind-up or elongation, stretch, verbal cues, visual cues, appropriate resistance, approximation or traction, normal timing, desired contraction type, and irradiation. These principles might form a "checklist" of sorts that a therapist might use to evaluate his or her treatment and to improve upon the effectiveness of the treatment. In the following paragraphs, I will attempt to describe each of these principles and its potential role in canine rehabilitation.

PATIENT POSITION

The position of the patient must be considered by the therapist in evaluating the effectiveness of the treatment. Considering the input that proprioception and integral reflexes and reactions have on the resulting movement (or lack of movement) is essential. For example, in lateral recumbency (or sidelying), extension of the limbs is promoted in the weight bearing extremities and flexion of the limbs is promoted in the nonweight bearing extremities. Therefore, if a paraparetic dog has abnormal flexor tone in the hind limbs, treatment in a lateral recumbent position might help to relax (or enhance) this tone. Other considerations might include the presence of vestibular impairments and/or reduced proprioception. How does the position of our patient influence these neurological systems? What "feedback" is the dog getting from its position in space.

THERAPIST POSITION AND BODY MECHANICS

Certainly, to maximally extend the duration of our careers as active, treating therapists, especially while treating a population of, at times, constantly-moving canines, we must consider our position and body mechanics during treatment. The PNF philosophy instructs that the therapist should always be "in the diagonal" and in the desired line of movement of the extremity. For example, if we are attempting to promote hock flexion with hip and stifle flexion (ie, during the swing phase of gait), our eyes, hands, forearms, shoulders, trunk, hips, feet, etc. must be pointed cranially and dorsally, into the direction of the desired movement.

Additionally, Ms. Knott instructs that we do not resist (or assist) the patient with our hands, but rather, relax our hands (as the tension in our hands will be reflected as tension in our patients), "feel the movement," and shift our body's weight for resistance (or assistance).

DESIRED PATTERN OF MOVEMENT

In human medicine, PNF patterns are functional diagonal and spiral mass-movement patterns of the trunk, neck, and extremities. PNF patterns have yet to be officially documented in canine rehabilitation, although inherent diagonal and spiral patterns are evident in the observation of functional activities, incorporating components of sagittal, frontal, and transverse plane motions. As in the human, functional limb movements are multi-joint, massed movements that are modified by the presence of deficits in strength, flexibility, range of motion, and/or tone of one or all of the movement components, which includes the spinal column.

PNF patterns are important not only because of the inherent functionality of the movement pattern, but also because when a movement is "in the groove" or "in the diagonal" there is a resultant strengthening of each of the components of the massed movement, a normalization of neuromuscular tone, a strengthening of irradiation, and the promotion of a better quality stretch response (ie, the response is quicker and stronger). These results of the diagonal PNF movement have been demonstrated clinically in human rehabilitation, however, to my knowledge, have yet to be demonstrated in canine rehabilitation.

MANUAL CONTACTS

Modification of the quality, quantity, and location of manual contacts can result in input to the patient's central nervous system, which is either inhibitory or facilitatory to the desired movement outcome. As was mentioned previously, a manual contact with excessive tension applied by the therapist might result in further tension in the patient and lead to inhibition of the desired movement.

In the same way, the application of multiple manual contacts might be inhibitory to movement when the result is an overwhelming and confusing number of inputs to the

sensory system of the patient. For this reason, a "lumbrical grip" is used in PNF to focus the manual contact as a single simplified stimulus for the patient. The application of this "lumbrical grip" to the muscle which is to be facilitated, might stimulate that muscle's contraction and encourage the patient to move the limb in a direction opposite the direction of the therapist's applied pressure (ie, pressure to the quadriceps in a caudal and ventral direction will elicit quadriceps contraction and movement of the limb into a direction of hip flexion). This allows for manual resistance, which must be of appropriate quality and quantity, of functional movement patterns.

WIND-UP OR ELONGATION AND STRETCH

In neurologically-involved patients, especially those showing signs of recovery with increased muscle tone, using a wind-up or elongation followed by a stretch might facilitate an active contraction. Winding-up involves "taking up slack" in the PNF pattern of movement, maximally elongating the major movers involved in the movement pattern, resulting in the increased likelihood of a maximal contraction. Winding-up also promotes and potentiates the stretch reflex in the muscle spindle. Following a wind-up into the desired PNF pattern, the stretch reflex is elicited. The goal of this procedure is to improve the contraction of weak muscles, to facilitate the initiation of voluntary movement, and to increase the strength of this voluntary movement. As with any reflex, the stretch reflex shows signs of fatigue with a decreasing intensity of response with multiple applications, however, it might be beneficial to initiate active joint movement.

An example of its use follows. The hind limb is elongated into a position of hip extension/abduction/internal rotation with stifle extension and hock extension. A quick stretch further into this elongated position is performed. The result is the initiation of an active contraction into hip flexion/adduction/external rotation with stifle flexion and hock flexion. (Additionally, pinching the toes for a withdrawal reflex following a wind-up might be as effective as using the stretch reflex.) Use of wind-up and the stretch reflex (in dogs OR humans) should be judicious and not performed without adequate instruction as it can be painful or damaging if used improperly.

VERBAL CUES

Most dogs understand even the most basic commands and with repetition and over time might continue to learn new commands. Regardless, the quality of the verbal cue, including tone and volume, can either inhibit or facilitate your patient. Verbal cues, if used, should be specific, concise, and coordinated with the performance of the activity. An example of the use of a verbal cue, timed with a resisted PNF pattern is that of the command "shake" with a resisted shoulder extension/adduction/internal rotation, elbow flexion, and wrist extension pattern.

VISUAL CUES

In human PNF practice, the therapist might ask the patient to look at the exercising limb so that the patient, even with sensory or proprioceptive deficits, might be provided with more feedback concerning the quality (and accuracy) of his limb movement. With patients who are lethargic, the use of visual cues assures the therapist that the patient is attending to the activity at hand. Obviously, in the canine rehabilitation world, treats and toys are easily employed as visual cues to motivate the patient to move as the therapist desires. Keeping in mind that eye movement influences head movement and that head movement influences trunk movement, visual cues can be invaluable.

APPROPRIATE RESISTANCE

Early in the practice of PNF, significant manual resistance was applied to promote irradiation. Unfortunately, this inappropriate resistance also resulted in abnormal reflexive and compensatory movements, increased muscle tone in already spastic patients, increased blood pressure via the valsalva maneuver, and a general misunderstanding that the therapist and patient were competing at "arm-wrestling" or a "strongest man contest." More recently, the emphasis in PNF education and application is on the use of appropriate resistance, which might, in actuality, be assistance. Resistance in PNF must be tailored to the patient's condition and the goal of the activity. Pain is never a goal in PNF practice, as pain is inhibitory.

APPROXIMATION OR TRACTION

The use of approximation or traction during the application of PNF patterns is an option which might enhance the patient's response. As some humans respond positively to approximation and others to traction, the same can be said for our canine patient population. Generally, the application of approximation through a joint during PNF treatment results in stabilizing co-contractions of antigravity muscle groups. Conversely, traction might promote mobility by reducing the effects of gravity and alleviating pain during the joint motion.

NORMAL TIMING

Timing refers to the sequence of muscle contractions, which results in coordinated movement. In the human adult, distal to proximal timing is the norm (ie, dorsiflexion occurs prior to hip and knee flexion when taking a step). Further detailed gait and functional mobility analysis is necessary prior to making assumptions concerning normal timing in the canine patient.

CONTRACTION TYPE

The type of muscle contraction, whether concentric, eccentric, or isometric, desired during treatment is based on assessment of the patient's motor control during functional activities. For example, if a patient (human or canine) is able to rise from a sitting position with normal motor control, but is unable to lower himself to a sitting position with appropriate control (ie, "plops"), treatment might focus on eccentric strength and motor control of the quadriceps muscles.

IRRADIATION

Irradiation is not always a sought-after outcome of PNF treatment, but should be purposeful and goal-directed when used. When irradiation leads to excessive and compensatory movement patterns (abnormal synergies), it is undesirable. Irradiation, however, might be used to promote strength in a weak extremity by resisting motion in a strong extremity or movement pattern and, thereby feeding into the trunk and weak extremity. We find that irradiation can be useful to facilitate bilateral hind limb hip flexion when bilateral shoulder

flexion, neck flexion, or trunk flexion is resisted. Additionally, irradiation might be used to strengthen a weaker component of the limb pattern by resisting a stronger component. For example, resisting hip flexion/adduction/external rotation can cause irradiation to effectively strengthen a weak stifle flexion or hock flexion component. The technical description of this specialized technique, timing for emphasis, is beyond the scope of this article.

CONCLUSION

Proprioceptive neuromuscular facilitation (PNF) is a method of manual treatment that this author has found to be efficient and effective in treatment of both humans and canines with neuromuscular and musculoskeletal disorders. Through further clinical observations and research (especially functional movement and gait analysis), we might be able to more concretely describe PNF patterns, procedures, and techniques that are applicable to canine rehabilitation. For the time being, I encourage you to further explore (and share!) your knowledge base and manual skills for continued application of traditionally "human" rehabilitation strategies and tactics so that we might further benefit our canine patients and clients.

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foot&ankle

SPECIAL INTEREST GROUP

RUNNERS ARE A SPECIAL POPULATION… OR ARE THEY?

A Commentary by Clarke Brown

Any practitioner actively treating foot/ankle impairments faces multiple challenges, including the determination of a working diagnosis and the development of a plan of care which is, in itself, dependent upon a quality and thorough examination. In the case of the most distal portion of the lower extremity, the patient improves, weightbearing capacity increases, and assistive devices begin to go away. Easy, right? Not so fast! All lower extremity patients, including the foot/ankle, seem to adopt a *runner mentality* to some extent, expecting weightbearing and strengthening to occur instantly and allow miraculous restoration of mobility-dependent ADLs. Hence, we practitioners commonly hear questions like: "Can I start running now?" (bunionectomy sutures are still present), or, "can I go to the mall now?" (24 hours following cast removal), or insert your own patient impatience.

In our office, we kid around that runners are unrealistic when it comes to rationalizing return to athletics following injury. That degree of dedication may only be superseded, at times, by tri-athletes. As we all know, these two groups of people are endorphin-addicted populations often self-medicating with neuro-transmitters through obsessive exercise. I have seen this scenario *twice;* a post-bunionectomy runner enters the office with an immobilizer of some type. "Why the boot?" The response: "Well, I knew I would be on the shelf, so I turned up my mileage and intensity and caused a stress fracture. I figured now is the time to get one, since I am not running anyway."

Yes, we have all seen the signs of clandestine activity which are NOT restricted to the over-the-top exercisers: fresh grass stains, unexplained edema, and the sudden appearance of sesamoiditis ("I knew it was wrong to run, but I figured the elliptical was ok").

Alas, the Temporary IQ Deficiency Syndrome (TIQS) is not limited to the runner groups. As soon as a foot/ankle patient begins to feel better, they begin to quickly advance their weightbearing…often, without realizing it. "There was no food in the house and I leaned on the grocery cart!" "If I walk on the outside of my foot, the big toe does not hurt at all!" Or, "I figured that if soaking in Epsom salts is good, going for a walk in the ocean would be even better!"

Upper extremity maladies can get a splint, a sling, or can be shoved cosmetically into a pants pocket. The lower extremity just gets abused. "I can't carry packages if I use a walker, you know!" "It's not like I ran the course… I just walked it so that I would know the route for next year." Like catching a child with his hand in the cookie jar, you can most certainly catch lower extremity patients doing "too much," and sometimes delaying their progress.

We practitioners need to identify and control these counter-productive behaviors whenever possible and be aware that *everyone* has a bit of TIQS occasionally. Try to be clear and comprehensive in your advice, perhaps ad nauseum, for our most recent marathoner rationalizes: "You told me not to run 10 miles, so I jogged it!"

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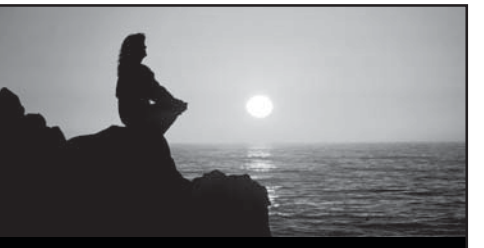

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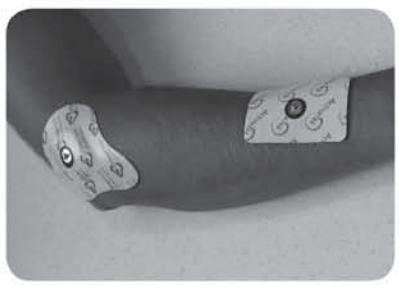

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