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Editor's Note

Stiffness: A Challenge to Measure and a Challenge to Treat

Christopher Hughes, PT, PhD, OCS

As the winter season bears down upon us I am reminded of one patient symptom that seems to increase in prevalence during this time period; patients complaining of increased stiffness. Many patients, especially older patients, commonly link weather changes to joint stiffness. The link between the study of weather and climate on living things is called "biometeorology." Jokingly they allude to moving to a warmer climate as part of their PT intervention. All things considered I know stiffness is not exclusive to the winter season and any strong scientific correlation between barometric pressure changes and the specific symptom of joint stiffness has not been clearly established. Many factors can play a role in the complaint of stiffness. One plausible explanation can be presented by considering the impact of barometric pressure on hydrostatic loading. The joint capsule contains fluid and will undergo a change in its hydrostatic properties with changes in barometric pressure. As the barometric pressure drops, the hydrostatic loading on the body decreases. This drop in external pressure impacts fluid retention in the joints, specifically, it leads to more fluid retention. This additional fluid retention puts additional pressure on the joint space ultimately creating a feeling of "stiffness." Any convincing data relating to the symptom of stiffness or lack thereof seems to be related to more the CHANGE in weather as opposed to winter weather specifically. So even when people move to a warmer climate their bodies will adapt to the current climate so I am not sure moving to a warmer climate totally resolves the issue. In addition this strategy would not be an advantage for patients dealing with stiffness as a consequence of postoperative swelling or immobilization. Humidity and altitude play a role as well but let's stick to PT!

Joint stiffness has specifically received much negative attention due to its restrictive effects on segmental and joint range of motion. So much so that the term stiffness is routinely elevated to the term "frozen" in one of the most challenging conditions of the shoulder…the dreaded frozen shoulder or more descriptively known as adhesive capsulitis.

All in all we know very little about stiffness and more importantly how to accurately measure this clinically. From an engineering standpoint, stiffness has very precise meaning which is beyond the scope of this editor's message. Clinicians treating orthopaedic conditions apply the term stiffness to describe a loss of movement freedom either arthrokinematically or osteokinematically. Physical therapists deal with stiffness as a result of many different conditions. Whether our patients have stiffness from disease, surgery, immobilization, trauma, or general joint changes with aging, stiffness is real and is something that has to be dealt with.

So how much do we really know about this condition? More importantly, how accurately can we measure this condition, and do our treatments really do what we think they do? In the clinic, a traditional posterior to anterior (P/A) glide applied to the spine is commonly used for assessment and treatment. However, as common as this method is it suffers from significant limitations. Accurate determination of stiffness or joint/segment motion loss is an important assessment. For example there is a fine line between the consequence of determining hypermobility and hypomobility and selecting a treatment of mobilization or manipulation or viewing these techniques as contraindications. I believe there is a void in our body of knowledge in this area in terms of accurate clinical measurement. We are left to subjecting the joint to motion or applying a P/A glide and then say the joint/limb is "stiff." Researchers have used more elaborate mechanical devices and methods to attempt to standardize the measure of stiffness and accurately assess treatment efficacy. In their recent study published in the *Journal of Orthopaedic and Sports Physical Therapy*, Campbell and Snodgrass determined if thoracic manipulation alters the posteroanterior (PA) spinal stiffness of the thoracic spine.[1] Thoracic PA

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spinal stiffness was measured at 5 vertebral levels in asymptomatic subjects, before and after manipulation. Five cycles of standardized mechanical PA force were applied using a custom-designed stiffness assessment device. Even with this device the researchers found that in asymptomatic individuals, thoracic PA spinal stiffness was not significantly different when measured before and after thrust manipulation. Oatis, Wolff, and Lennon measured knee joint stiffness in subjects with and without knee OA by calculating stiffness and damping coefficients from the angular motion of the knee during a relaxed oscillation.[2] Commercial devices like the Pulstar™, which is more prevalent in the chiropractic field, propose to be able to assess and treat tissue that exhibits tissue stiffness by applying multiple impulse therapy to change tissue compliance (the inverse of stiffness).[3]

Ironically stiffness is not the bad guy in all cases. We rely on contractile elements and periarticular elements of the spine to impose greater "dynamic" stiffness and ultimately add to the stability of an otherwise mechanically weak and inherently unstable spinal unit.[4] Segmental spine buckling resulting in tissue damage may be attributed to the sudden onset of low back pain, even during activities that require submaximal loading and muscle activation.[5] In this case, stiffness by these tissues is a welcomed advantage.

Despite its prevalence across diagnoses, I am wondering why more attention isn't paid to addressing the accurate measurement and treatment of stiffness in orthopaedic physical therapy. Maybe it's time we get back to basics to improve our understanding of such a common complaint and condition. Future studies on the histological, physiological, and mechanical effects of joint stiffness can help the everyday clinician in developing more effective interventions for the "stiff joint."

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Anterior Cruciate Ligament Laxity and Strength of Quadriceps, Hamstrings, and Hip Abductors in Young Pre-pubescent Female Soccer Players Over Time: A Three-year Prospective Longitudinal Pilot Study

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ABSTRACT

Purpose: This was a longitudinal study to determine the effects of maturation on anterior cruciate ligament (ACL) laxity and muscle strength in pre-pubescent female soccer players. **Methods:** ACL laxity and quadriceps, hamstrings, and abductors strength were measured annually from 2006 through 2008 in 22 pre-pubescent female soccer players, ages 7–12yrs. **Results:** ACL laxity increased 2.2 mm ($p < 0.0002$) in 2007 and 1.7 mm ($p < 0.005$) in 2008. Quadriceps strength increased 1.9 kg ($p < 0.01$) in 2007 and 2.1 kg ($p < 0.009$) in 2008. No significant change was noted in the hamstrings. Abductor strength decreased 3.0 kg ($p < 0.0001$) in 2007 and 2.3 kg ($p < 0.0001$) in 2008. Quadriceps to hamstring (Q/H) ratio decreased 0.4 kg ($p < 0.02$) in 2008. **Conclusion:** ACL laxity increased with age in pre-pubescent girls. The high Q/H ratio, and decreased abductor muscle strength, indicates an increased risk of ACL injury. Significant changes at age 11.5 occur both in ACL laxity and muscle strength, just one year prior to average age of menses. Girls may be approaching puberty with pre-existing muscle weakness and imbalance that may expose them to ACL injury.

Key Words: pre-pubescent female athlete, anterior cruciate ligament laxity, quadriceps to hamstring ratio

INTRODUCTION

Participation in organized instructional and competitive sports programs has become progressively more popular among young children through both school and club organizations. Frommer and Masaracchio[1] reported that 50% of today's pediatric population plays in organized sports. More specifically, an estimated 2.1 million girls between the ages of 7 and 11 years participated in organized soccer in 2005.[2] In the past 10 years alone, a 21% increase in sports participation has resulted in an increase in sports injuries in the pediatric population.[1] Leiniger et al[3] found an increased rate in soccer-related injuries of 1.14 to 1.63 per 1000 girls aged 2-18 from 1990 to 2003. During the same time period, injury rate remained unchanged in boys. Furthermore, ACL injuries occur at an extremely high rate in high school and collegiate female athletes, approximately 2 to 8 times more than in their male counterparts.[4-6]

While several theories have been postulated for the greater incidence of ACL injuries in females, it is important, as an injury prevention strategy, to examine those factors that may place girls at greater risk for injury. Dynamic knee stability, composed of passive ligamentous restraint and active muscular control, supports and stabilizes the knee during functional activities.[7,8] Knee ligament laxity has been shown to increase the risk of ACL injuries.[9,10] Hinton et al[11] found female teenagers to have greater ligamentous laxity compared to males. The greatest anterior tibial translation has been found to occur in early childhood and begins to decrease as the child approaches the eighteenth year of age, thus indicating young female athletes have greater ACL laxity and may be at high risk of anterior cruciate ligament (ACL) injury.[12]

Muscular strength, particularly in the quadriceps, hamstring, and hip abductor muscles provides a foundation for dynamic stability.[5] An increased quadriceps to hamstring (Q/H) ratio is a well documented risk factor for ACL injury.[13-16] The quadriceps act as an antagonist to the ACL creating an anterior shearing force on the proximal tibia, while the hamstrings assist the ACL in counteracting the shearing force of the quadriceps. Consequently, many ACL injury prevention programs seek to improve dynamic knee control by underscoring hamstring strengthening and proprioception.[17,18] A Q/H ratio considered to be 'normal' for female athletes ranges between 0.5-0.8 with an average of 0.6.[8] Ahmad et al[14] reported that female athletes exhibit quadriceps dominance after menarche, while Beenakker[7] and Buchanan[8] reported that pre-pubescent females exhibit a more equal Q/H ratio. Additionally, proximal frontal plane control of the hip, as evidenced by hip abductor weakness, may lead to greater knee valgus and be a risk factor for ACL injury. Hip abductor weakness may adversely affect knee stability and dynamic control in the frontal plane especially during activities requiring significant stance support.[5]

To date, most research on ACL injuries has been cross-sectional, focusing on high school and collegiate female athletes. Longitudinal designs are necessary to study the developmental changes in dynamic joint stability and ligamentous laxity in the pediatric population.[19,20] While there have been some investigations on the peri-pubertal female athlete, which begin around the age of 12,[21,22] the relationships between

ligamentous laxity and muscular strength in the very young pre-pubertal athlete remains unknown. With the growing participation of younger female children competing in organized competitive sports, it becomes increasingly important to understand when ACL laxity and significant strength imbalances occur that contribute to injury in this population.

The purpose of this longitudinal pilot study was to examine the effects of maturation over time on ACL laxity and the maximum voluntary isometric muscle strength in the very young pre-pubescent female soccer players. Specifically, the lower extremity muscle groups of interest were quadriceps, hamstrings, and abductors along with the calculated Q/H ratio.

METHODS

Sample

This longitudinal study was conducted at Fair Lawn All Sports Complex (Fair Lawn, NJ). The subjects were measured in consecutive years each spring from 2006-2008. Twenty-two subjects were recruited through verbal presentations and by flyers from the Fair Lawn All Sports Recreational Soccer League in the spring of 2006. Premenarche girls were included between the ages of 8-12 years if they were actively participating in organized soccer and willing to participate in annual measurement sessions. Subjects were excluded if they experienced a single menstrual period, an orthopaedic condition of the lower extremity within the last 6 months, or any chronic medical condition that precluded exercise. Study procedures were fully disclosed. All parents/guardians signed written consent forms and the subjects gave signed written assent forms that were approved by the Columbia University Medical Center Internal Review Board (#AAAA 8582). Confidentiality was maintained by assigning subjects an identification number that was used for all analysis.

Procedure

The same procedures were consistently performed for each measurement session that occurred in the spring of 2006, 2007, and 2008. Following informed consent, age, height, and weight were recorded. Body mass index (BMI) was later calculated using the US Center for Disease Control and Prevention's (CDC) guidelines for age. A general health interview that included menstrual history, sleep patterns, and other pertinent medical conditions was obtained from parents and subjects. The *Activity Rating Scale for Disorders of the Knee*[23] is a reliable tool (ICC 0.97) used to assess specific tasks that stress the ACL during activities such as cutting and decelerating. This normally self-administered questionnaire was used as a structured interview to permit parents to assist the subjects. Leg dominance was determined as the subject's kicking leg. Anterior cruciate ligament laxity was measured as the amount of anterior tibial displacement while applying a 133 N anterior load to the posterior tibia using a KT-1000 knee arthrometer (MEDmetric Corp, San Diego, CA). Inter-rater reliability for the two testers examining laxity was found to be good (ICC $\geq$ 0.83) in a pilot study consisting of 3 trials each for 5 subjects. Laxity measurements were performed with the subject lying supine with a pillow under her head, hands resting on the abdomen, and feet positioned with heels resting on the KT 1000 Foot Support. The arthrometer support platform (11 cm in height) was used to position the subject's dominant knee between 20° and 30° of flexion. The arthrometer was secured with two Velcro straps placed over the anterior aspect of the tibia. The subject's tibial length was adequate to accommodate the length of the arthrometer. The examiner palpated the knee joint line, and aligned the joint line arrow on the arthrometer accordingly. The arthrometer was positioned and zeroed by the examiner with one anterior-posterior pull and push until one unified tone was heard in both directions. To determine the start position, the examiner pushed posteriorly until one unified tone was heard and the needle displacement returned to within ± 0.5 of a 0 reading, 3 times in a row. The examiner provided stabilization with one hand on the patellar pad while pulling anteriorly at a slow and constant speed on the handle until the third tone was heard. Three trials were performed and averaged.

Strength was measured as the maximum voluntary isometric muscle contraction using the Lafayette Manual Muscle Test System (Model 01163, Lafayette Instruments, Lafayette, IN) Hand Held Dynamometer (HHD) by 3 testers. Intra-rater reliability was found to be good in a pilot study consisting of 3 trials of 5 subjects for each muscle group as follows: quadriceps (ICC $\geq$ 0.87), hamstrings (ICC $\geq$ 0.9), and abductors (ICC $\geq$ 0.83). These values are consistent with previous reports where reliability has been assessed with student testers using the same equipment.[24-27]

Careful positioning was used to ensure accuracy of the strength measurements in this age group. To measure the maximum voluntary isometric quadriceps strength, the subject was supine with heels resting on the arthrometer foot support and the arthrometer support platform positioned in the popliteal fossa to create a knee flexion angle of 20°-30°. The HHD was positioned with a belt 2 to 3 centimeters proximal to the anterior aspect of the midpoint of the malleoli. A two-centimeter block was positioned between each subject's heel and the foot platform and the belt was then tightened to allow a 6-centimeter space between the foot and HHD. Belt resistance was used in conjunction with the examiner's force to stabilize the young subjects and standardize amount of counterforce. The block was then removed and the subject performed a maximal contraction. The maximum voluntary isometric hamstring strength was measured with the subject prone with feet resting on the arthrometer support platform so that the knee flexed 20°-30°. The HHD was placed on the posterior aspect of the tibia between the malleoli 2 to 3 centimeters proximal to the attachment of the Achilles tendon. The maximum voluntary isometric abductor strength was measured with the subject sidelying with the bottom hip and knee flexed to 90°, and the arthrometer support platform placed under the medial aspect of the distal tibia of the extended top leg. The HHD was placed on the lateral aspect of the extended leg, 2 to 3 centimeters proximal to the lateral malleolus. A second tester stabilized the subject's pelvis to avoid hip flexor co-contraction, a common substitution in the age group. For each of the 3 muscle groups undergoing strength testing, the measurement protocol was consistent. Three consecutive maximum contractions were completed with a 20-second rest in between each measurement. To motivate the young subjects to complete a 6-second maximum contraction, the examiners encouraged the subjects with verbal cues such as "kick, kick, kick, kick, kick."

Statistical Analysis

Descriptive statistics (mean, SD, and range) were used to summarize height, weight, activity level, and BMI for each subject. Descriptive statistics were performed for ACL laxity and strength measurements at each testing.

Table 1. Age, BMI, and Activity Level by Measurement Year

	Spring 2006 n=22	Spring 2007 n=16	Spring 2008 n=22
AGE (months)			
Mean	113.25	128.10	138.00
SD	18.87	18.75	16.55
Range	81-144	96-159	113-172
BMI [25,26]			
Mean	18.0	19.6	19.4
SD	3.04	3.07	2.43
Range	13.5-22.7	14.5-25.6	15.-23.0
ACTIVITY LEVEL [22]			
Mean	11.9	13.2	13.8
SD	3.81	2.64	2.70
Range	3-16	5-16	8-16

Table 2. ACL Laxity (mm) of the Dominant Leg by Measurement Year

	Spring 2006 n=22	Spring 2007 n=16	Spring 2008 n=12
MEAN	5.0	7.3*	7.1⁺
SD	2.10	2.19	1.99
RANGE	3.0-8.5	4.0-11.3	4.3-10.8

*2007:2006 $p = 0.0002$
⁺2008:2006 $p = 0.005$

Table 3. Muscle strength of the dominant leg by measurement year

	Spring 2006 n=22	Spring 2007 n=16	Spring 2008 n=12
QUADRICEPS)			
Mean	9.90	11.85*	7.60⁺
SD	3.62	3.96	1.67
Range	7.3-16.2	5.4-20.3	4.2-10.5
HAMSTRINGS			
Mean	8.4	9.60	9.14
SD	4.30	3.71	3.49
Range	2.6-14.7	3.6-17.1	5.1-15.4
ABDUCTORS			
Mean	7.76	5.10**	5.45⁺⁺
SD	2.34	1.77	2.19
Range	1.7-11.2	2.8-9.3	1.7-9.5

*2007:2006 $p = 0.01$
⁺2008:2006 $p = 0.009$
**2007:2006 $p = 0.0001$
⁺⁺2008:2006 $p = 0.0001$

A separate linear mixed effects model (LME) with random intercept using the Comprehensive R Archive Network was used to analyze each variable (age, laxity, and strength). An LME was performed to determine what percent of variability could be accounted for by subject characteristics, strength, and laxity changes from spring 2007 to spring 2006, and from spring 2008 to spring 2006. This model accounts for the correlation that exists within the data of the same girl over time. Each model separately compared the measurements taken in 2007 and 2008 to the baseline measurement of 2006. The fixed effect was the year and baseline age while the random effect was the intercept--either laxity measurement or strength measurement. The statistics were analyzed with assistance of the Biostatistics Consultation Service and the Irving Institute for Clinical and Translational Research at Columbia University Medical Center.

RESULTS

Subjects

Twenty-two girls joined the study in the spring of 2006 with a mean age of 9.4 years (range 6.7-12.0 years). In the spring of 2007, 16 girls returned yielding a participation rate of 72%. Finally, in the spring of 2008, 12 girls were measured for a participation rate of 60%. The means, standard deviations and ranges for age, BMI, and activity level for all subjects in each year of study participation are presented in Table 1.

ACL Laxity

Anterior cruciate ligament laxity for the dominant leg by measurement year is presented in Table 2. The baseline age was rescaled so that it is adjusted to initial measurement day per 12 months. The LME model for ACL laxity significantly increased by 2.2 mm (LME; $p < 0.0002$) from the baseline in 2006 to the measurement in 2007. Anterior cruciate ligament laxity also significantly increased by 1.7 mm (LME; $p<0.005$) when the 2006 baseline was compared to 2008.

Muscle Strength

The mean, standard deviation, and range for the strength of the quadriceps, hamstrings, and abductor muscle groups by measurement year are listed in Table 3 and are graphically depicted in Figure 1. There was a significant increase in quadriceps strength of 1.9 kg (LME; $p < 0.01$) from the baseline in 2006 compared to 2007 and a significant increase of 2.1 kg (LME; $p<0.009$) from 2006 to 2008. There is no statistically significant change noted for any of the hamstring measurements though hamstring strength slightly increased from 2006 to 2007 and then slightly decreased from 2007 to 2008. Abductor muscle strength significantly decreased by 3.0 kg (LME; $p < 0.0001$) from 2006 to 2007 and significantly decreased 2.3 kg (LME; $p < 0.0001$) from 2006 to 2008. The abductors were the only muscle group to decline from 2006 to 2007. The quadriceps to hamstring ratio decreased for each measurement year as can be seen in Figure 2. This decrease was not a significant change from 2006 to 2007. However, there was a significant decrease in the Q/H ratio of 0.4 kg (LME; $p < 0.02$) from 2006 to 2008.

DISCUSSION

This study examined changes in ACL laxity and isometric strength in very young athletic girls over 3 consecutive pre-pubertal years. Anterior cruciate ligament laxity increased as the participants approached puberty. The largest increase in ACL laxity found was 2.3 mm from 2006 to 2007 as the mean age increased from 9.5 years to 10.5 years (see Table 2). With measurements taken in the spring 2008, ACL laxity appeared to plateau at age 11.5 years. To our knowledge, there are no known published reports of ACL laxity measurement of female athletes younger than the age of 11. Hinton et al[11] reported on changes in ACL laxity of normal males and females 11 to 18 years old concluding that, despite some fluctuations, there was a generalized decrease in ACL laxity for both genders. However, females exhibited greater laxity when compared to their male counterparts with the largest laxity noted between the ages of 11 and 12. Our results suggest that the laxity peak in girls noted by Hinton et al11 may begin at a younger age than previously reported. This greater laxity demonstrated by these very young female athletes puts them at greater risk for ACL injury.[9,10]

We investigated isometric strength of quadriceps and hamstrings in relation to age longitudinally noting strength appeared to change from year to year (Figure 1, Table 3). In our study, quadriceps muscle strength significantly increased from 2006 to 2007 as the mean age of the girls increased from 9.5 to 10.5 years, while quadriceps muscle strength statistically decreased in 2008 as the mean age approached 11.5 years. We found that hamstrings strength appeared to be the most stable, showing no significant changes in each of the 3 successive years. To our knowledge, the only other study examining strength in this age group was Beenakker et al[7] who, to establish norms, measured isometric strength using a HHD in a cross-sectional study of children specifically grouped by chronological year. Beenakker et al[7] found quadriceps strength increased each year, beginning at age 8, while hamstring strength improved annually and then declined at age 10. Boys had significantly stronger quadriceps and hamstrings than did girls at age 10, but this sex difference in strength disappeared between the ages of 11 and 13. In adolescents, Buchanan and Vardaxis[8] compared quadriceps and hamstring strength isokinetically in male and female basketball players in two separate age groups, 11-13 and 15-17. Similar to Beenakker et al,[7] Buchanan and Vardaxis[8] found no strength differential between genders in the 11-13 age group. One possible explanation for this lack of strength difference between genders is that at age 11 there appears to be a large growth spurt that may alter the muscle balance.[7,28] However, because we compared girls to their own strength assessment from the prior year we found fluctuations in strength not previously reported, which may indicate that girls approach puberty with pre-existing muscle imbalances.

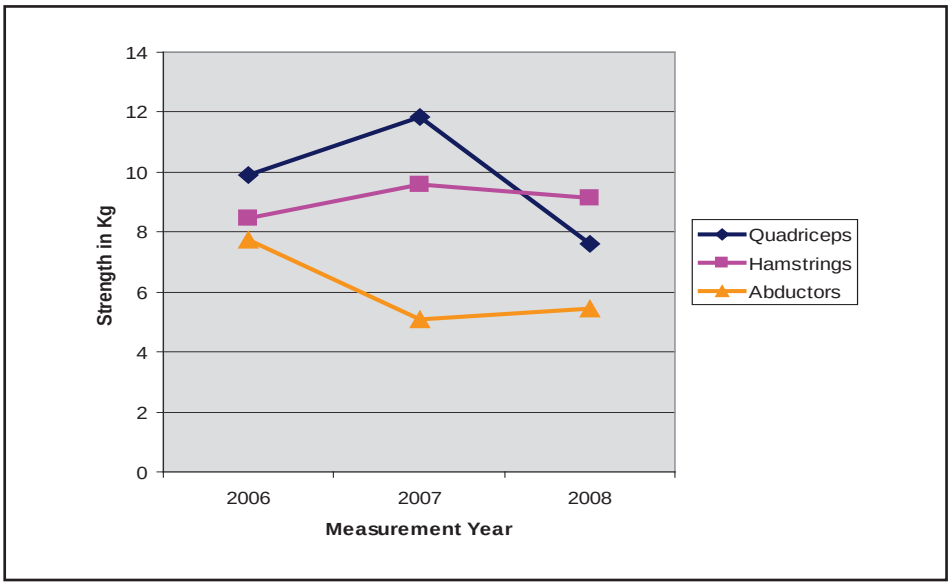

Figure 1. Muscle strength (kg) of the dominant leg by measurement year.

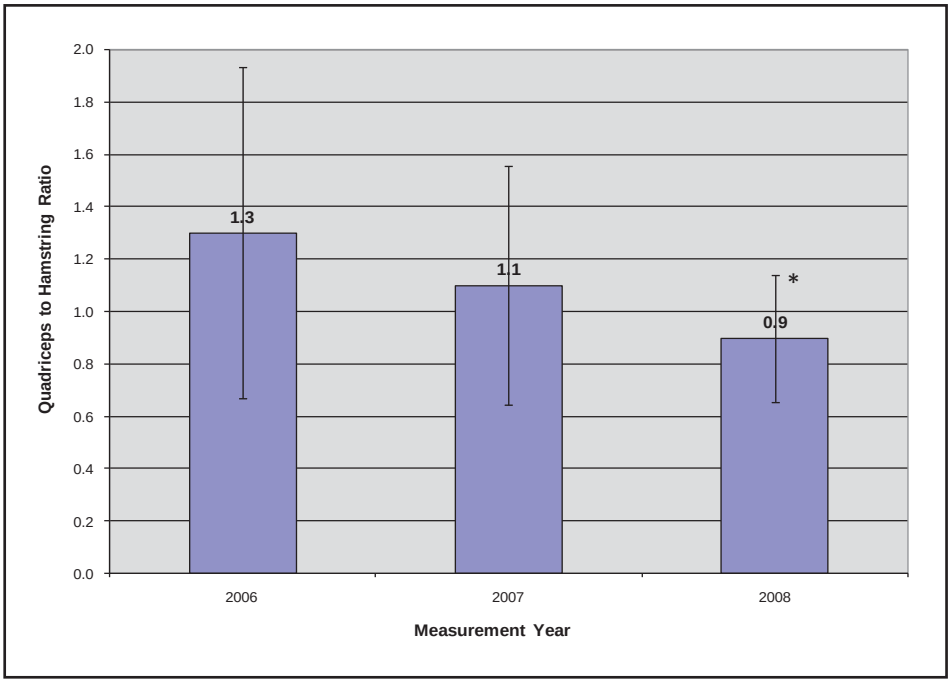

Figure 2. Mean Q/H ratio of the dominant leg by measurement year.

Relative weakness of hamstrings compared to quadriceps has been shown to be a risk factor for ACL injuries.[13-16] Our study further demonstrates the muscle imbalance between the quadriceps and hamstrings in this age group of young pre-pubescent girls as the Q/H ratio decreased each year with a statistically significant change of 0.4 from 2006 to 2008 (see Figure 2). This decrease in the Q/H ratio is largely due to a decline in quadriceps muscle strength rather than a change in hamstrings muscle strength. Several studies have demonstrated sex differences in Q/H ratios with males

exhibiting stronger hamstrings especially postpuberty.[8,14,29] These patterns depict a state of relative quadriceps dominance over hamstrings strength in adolescent females. While the Q/H ratio decreased in this study, our value of 0.9 in 2008 still indicates relative quadriceps dominance compared to the average Q/H ratio of 0.6 in this population.[9]

Comparing a girl's strength changes over time shows a pattern of individual change as opposed to group comparisons between genders. This unique feature of our longitudinal study indicates a decrease in prepubertal quadriceps strength around the age of 11.5 years at the initiation of long bone growth in girls and parallels the equalization of strength measurements between genders noted in the 11-13 age group.

Hip abductor muscle strength significantly declined in our sample of young prepubescent girls over the 3-year course of this investigation. Strength of the hip musculature is increasingly being recognized as critical for proximal control to produce optimal lower extremity kinematics and prevent injuries in young athletes.[22,30,31] A decrease in hip abductor muscle strength has been shown to be related to increased valgus in single limb weight-bearing activities such as a single-leg squat,[32] a single-leg step down,[33] and a two-legged hop into a single-leg landing.[30] Girls exhibiting increased knee valgus under these dynamic conditions are at greater risk for ACL injuries.[6,17,34] As girls undergo their rapid growth spurt, limb length and pelvic width increase that may alter the length tension relationship of the hip abductors, potentially facilitating weakness. Young prepubescent girls, who exhibit hip abductor weakness prior to their pubertal rapid growth, may be predisposed to dynamic valgus in landing.

Limitations of this study include the relatively small sample size and retention rate and the inability to control for activities on the days of testing. Study attrition was primarily reported by the parents and girls to be due to scheduling conflicts and a lack of an incentive to participate. Based on interviews with girls and parents, subject drop-outs seemed to have been due solely to scheduling conflicts and not to factors that influence ligament laxity or muscle strength. To our knowledge there are few, if any, longitudinal studies on this age cohort of girls. Despite the small sample of girls that completed all 3 years of measurement our results can serve as a guideline for conducting future longitudinal studies on this population.

The girls in this study were an extremely active group and were participating in various activities such as games, practices, or girl scouts on the day of testing prior to measurement. While muscle fatigue is unlikely, motivation and concentration may not have been consistent throughout all testing procedures. Throughout this study, BMI remained constant indicating that subjects maintained a BMI healthy for age according to the CDC guidelines.[35] Since BMI remained constant we do not believe that expressing strength as a function of body weight is appropriate in this age group of children since we were comparing each girl to her own baseline measurement. Strength in children does increase with age, height, and weight. However, there are conflicting reports as to which of these factors exert the greatest influence on strength. These conflicting reports may be due to the tremendous variability in the samples with respect to height and weight for each age. Based on the general health interview, each girl maintained high activity levels throughout the year by playing multiple sports such as soccer, basketball, softball, and swimming. The results of the activity rating scale indicated that all subjects participated in the highest level of activities that stress the ACL. We chose the Activity Rating Scale as it assessed stresses to the ACL during various physical activities. However, this scale was not developed for pre-pubescent females and is most often used for persons between the ages of 18 and 50.[23] A scale that incorporates ACL stresses and age appropriate activities would have allowed us to account for this variable.

The targeted age population, young pre-pubescent girls, is a very difficult group to investigate, yet results of our study and others suggest that significant changes in ligament laxity and knee strength put this population at risk for injury. Young prepubescent girls' participation in sports is voluntary; however, busy parents are required to juggle schedules to facilitate involvement in both sporting activities and testing sessions. To better capture this important age group of girls, we recommend that future research provide incentives to participation for both the girls and parents throughout the study timeframe. For future research on the population, measurement sessions conducted within the context of the school system at a specified time of day would both minimize attrition and control for pretesting activity level.

The muscle imbalances found in high school and collegiate female athletes appear to occur earlier than previously thought. Our results suggest that the crucial changes seen in muscle strength places young prepubescent girls at risk for ACL injury. We recommend initiating prevention programs that concentrate on hamstring strengthening, knee dynamic stability, and proprioception for the pre-pubescent athlete. Considering the increasing numbers of very young girls participating in sports and activities that stress the ACL such as cutting, jumping, and landing, longitudinal investigations should occur at the age when organized participation begins. Future research should be directed at examining established risk factors for female ACL injuries in prepubescent females.

CONCLUSIONS

Anterior cruciate ligament laxity increased concurrently with the increase age in young pre-pubescent girls. Despite decreases in the Q/H ratio, relative quadriceps dominance continued as the girls approached puberty. This high Q/H ratio, partnered with the decrease in abductor muscle strength seen with increasing age, suggests the young pre-pubescent female athlete may be at an increased risk of ACL injury. Significant changes at age 11.5 occur both in ACL laxity and muscle strength, approximately one year prior to menses. We can no longer ignore this age group with the ever increasing participation in sports. Their activity level continues to grow exponentially and, thus, so does their risk for injury.

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The Influence of Balance and Postural Control on Shoulder Function in a Patient with Chronic Rotator Cuff Pathology

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ABSTRACT

Background: Patients with chronic rotator cuff tears present in physical therapy with functional limitations. The purpose of this case report is to describe the physical therapy management of a patient with chronic rotator cuff pathology, with an emphasis on balance and postural control directed at improving shoulder function. **Case Description:** The patient was a 62-year-old male with a severe, chronic right rotator cuff tear. Impairments included pain and functional limitations with reaching, lifting, dressing, and eating. Physical therapy included 8 visits within a 4-month period emphasizing balance and postural control interventions linked with upper extremity movement patterns. **Discussion:** Despite the chronic nature of the rotator cuff tear and the poor clinical and radiographic presentation, this physical therapy program that included balance and postural control strategy examination and interventions was helpful in restoring shoulder function. Conclusion: Following physical therapy, the patient improved active forward shoulder flexion to 140°without pain, DASH scores, performance on the Selective Functional Movement Assessment, and attained all his personal functional goals.

Key Words: RTC, impingement syndrome, rotator cuff tear, regional interdependence, anticipatory postural control, Selective Functional Movement Assessment

INTRODUCTION

Functional limitations, such as difficulty with reaching or throwing overhead, lifting objects, performing daily tasks at home, play and work in addition to pain, are common complaints of patients with rotator cuff tears. Factors that can influence the development of symptoms and functional limitations following a rotator cuff tear include the size of the tear, the location of the tear, postural alignment, and scapulohumeral dysfunction. Evidence indicates that patients with chronic rotator cuff disease who present with severe functional impairments and receive nonoperative treatment, such as rotator cuff strengthening and range of motion (ROM) exercises, demonstrate unfavorable results.[1-6] According to Vad et al,[7] patients with superior migration of the humeral head, decreased passive range of motion, and external rotation/abduction strength less than Grade 3 were likely to have poor functional outcomes with physical therapy without surgical intervention.

There have been several studies that report the expected outcomes for shoulder function following operative repair of large to massive rotator cuff tears.[8-14] Active forward flexion was used as one measure to determine successful outcomes for these patients following surgery. Attaining active forward flexion measures between 132°to 165° on follow-up indicated successful functional return of shoulder function.[8-14]

Upper extremity function requires raising the arm varying degrees and under various loads through a series of complex, synergistic muscle contractions. In a regional interdependent model, normal postural control of the lower extremities, pelvis, and trunk facilitates optimal shoulder function. Raising the upper extremity results in a voluntary perturbation of balance or postural equilibrium.[15,16] Prior to initiating voluntary upper extremity movement while in standing, the normal postural response is the activation of synergistic muscle activity in the lower extremities and trunk. This muscle activity precedes the upper extremity muscle activity.[15-25] The trunk and lower extremity muscle activity works in anticipation/preparation to compensate for the change in the center of gravity as the arm is moved. This response is called anticipatory postural control or anticipatory postural adjustment. The large muscles of the hips and trunk help position the thoracic spine to accommodate proper scapular motion.[23] Optimal scapulohumeral and scapulothoracic function has long been identified as integral for shoulder function.

The Selective Functional Movement Assessment[26,27] qualitatively assesses fundamental movement patterns, including posture and balance, necessary for functional activities of daily life. This assessment is designed to be used following a subjective examination and prior to specific tests/measures that contribute to the development of functional hypotheses. The Selective Functional Movement Assessment items include: Active Spine Movement, Total Rotation, Gait Checking including Hurdle Stance, Deep Squat, Combined Upper Extremity Movement, and Active Cervical Spine Movement.[26,27] The Selective Functional Movement Assessment is outlined in Appendix A. Each movement is classified as follows: functional and nonpainful, functional and painful, dysfunctional and nonpainful, or dysfunctional and painful. These classification terms are defined in Table 1.

The purpose of this case report is to describe the physical therapy management of a 62-year-old patient with chronic rotator cuff pathology, with an emphasis on balance and postural control directed at improving shoulder function.

CASE DESCRIPTION

This patient was a 62-year-old, right-hand dominant male who had been diagnosed with a chronic tear of the right rotator cuff by 2 orthopaedic surgeons. Each physician determined the diagnosis after examining the patient and reviewing the radiographs (Figure 1). Magnetic resonance imaging was deemed unnecessary based on the significant clinical findings on the radiographs. Numerous authors[28-41] have documented that superior migration of the humeral head apparent on the anteroposterior radiograph is consistent with, if not diagnostic of, a rotator cuff tear. In addition, a subacromial space narrower than 5 mm has been considered pathologic and strongly indicative of a supraspina-

Table 1. Initial Selective Functional Movement Assessment

Classification	Movement
Functional and Nonpainful	None
Functional and Painful	None
Dysfunctional and Nonpainful	Spinal forward bending Bilateral spinal side bending Bilateral total rotation Right hurdle stance (left single leg stance) Left hurdle stance (right single leg stance) Deep squat Left upper extremity pat Left upper extremity scratch Left upper extremity impingement (across) Cervical forward bending Bilateral cervical side bending
Dysfunctional and Painful	Spinal backward bending Right upper extremity pat Right upper extremity scratch Right upper extremity impingement (across) Cervical backward bending Bilateral cervical rotation

Functional – unlimited or unrestricted movement[26]
Nonpainful – no reproduction or increase in symptoms
Dysfunctional – movements that are limited or restricted in some way demonstrating a lack of mobility, stability, or symmetry within a given functional movement[26]
Painful – reproduces or increases symptoms, or brings about secondary symptoms that need to be noted[26]

Figure 1. AP radiographs of the right (involved) and left (uninvolved) shoulders. Note the significant superior migration of the right humeral head and complete loss (<5 mm) of the subacromial space of the right shoulder.

tus tendon rupture.[30,33,34,40,41] The patient expressed significant skepticism to the physician and the physical therapist regarding the potential for improvement based on his present condition, the chronic nature of the condition, and previous experiences of limited success with physical therapy.

The patient reported a history of chronic right shoulder dysfunction dating back over 30 years due to a skiing injury. He complained of increased right shoulder dysfunction (reaching and lifting) with a marked increase in pain over the past few months. He was unable to reach behind his back. Functional limitations were reported to be increased difficulty with eating and dressing. He was retired from full time employment but was interested in obtaining part-time work that he could perform with his limitations. He noted no pain while at rest during the interview. At the time of the initial interview, no medications had been prescribed for this condition. There were no significant co-morbidities reported.

The Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire was administered along with a medical history prior to the physical therapy examination. The patient's initial DASH score prior to physical therapy was 48.3/100, indicating a moderate level of disability.

The postural examination revealed a forward head posture, upper thoracic kyphosis, and right scapular depression. Active right shoulder flexion range of motion was 0° to 30° with end range pain reported (Figure 2). Active right shoulder abduction range of motion was initiated but could not be completed due to pain.

The Selective Functional Movement Assessment was performed with the results outlined in Table 1. On observation, the patient demonstrated severe restriction in movement with hip flexion substitution during right total rotation (Figure 3). The patient performed forward bending with minimal hip movement and excessive thoracic flexion (Figure 4). However, it was observed that overhead reaching was performed during forward bending without pain. The patient was unable to perform right hurdle stance (left single leg stance) without losing his balance. When asked to repeat the hurdle maneuver, the patient used both upper extremities in the high guard position.

Following the Selective Functional Movement Assessment, passive range of motion of the shoulder was examined since right shoulder movements were dysfunctional and painful with a positive impingement sign on the right. This was performed to assess whether shoulder mobility was restricted, limited by pain, or both. Results for passive range of motion of the right shoulder were: 0°-150° of flexion, 0°-120°of abduction, 0°-80° of external rotation, and 0°-60° of internal rotation. Manual muscle testing was not performed based on the degree of pain reported with active right shoulder movement.

The reproduction of right shoulder pain with active range of motion, functional movements of the upper extremity, and with active impingement was consistent with chronic rotator cuff pathology. Measures of passive range of motion for the right shoulder approached more normal ranges with considerably less pain when compared with motion performed actively. These findings indicated less shoulder mobility restriction than expected given the chronic nature of this condition and indicate the potential to restore active range of motion within the limits of the passive range of motion. In addition, right hurdle stance (left single leg stance) was severely limited as compared to

Figure. 2. Active right shoulder flexion range of motion on initial examination.

Figure 3. Right total rotation with hip flexion on the right.

Figure 4. Forward bending with excessive thoracic flexion.

left hurdle stance (right single leg stance), because the patient was only able to lift the right foot off the floor for less than a second while maintaining the left foot off the floor for several seconds. There were no quantitative measures of balance done because of the qualitative nature of the assessment tool. Based on the clinical decision making model of the Selective Functional Assessment, asymmetrical dysfunctional and nonpainful movements are addressed first to determine the potential impact on other dysfunctional nonpainful and painful movement patterns. In addition, this balance discrepancy was particularly obvious and alarming to the patient and the physical therapist. No formal vestibular screening was done because there were no reports of dizziness or loss of balance with change of position.

The physical therapy goals were established with the patient following the initial visit and addressed both impairment and functional levels. They were for the patient to demonstrate right hurdle stance and right total rotation to be symmetrical to the contralateral side within 4 weeks; and restore active right shoulder flexion to 0°-120°, report pain free right shoulder function during independent activities of daily living (eating and dressing) within 8 weeks.

The initial physical therapy program was developed with the results of the Selective Functional Movement Assessment providing valuable insight into the patient's movement limitations. The patient was instructed to perform right tandem stance with repeated bilateral upper extremity elevation. (Tandem stance was chosen based on the extreme difficulty exhibited with hurdle stance.) Following 2 sets of 10 repetitions with a one minute rest between sets, the patient was able to elevate the right upper extremity over 90° of forward flexion with minimal or no discomfort while in right tandem stance (Figure 5). On re-examination following the intervention, spinal alignment and the quality and extent of spinal mobility appeared to be subjectively improved. No objective measures were recorded. Based on the patient's dysfunctional and nonpainful forward bending, standing toe touches were performed with the heels elevated on a 2"x 4" board with the arms maintained overhead (Figure 6). This intervention was progressed to include 5 pound isometric toe touch raises from the floor within 3 months, because the patient was able to reach the floor and reported no onset of lumbosacral symptoms with the intervention without resistance. This intervention progression promoted overhead reaching in a gravity-assisted position. The passive lock and lift exercise (Figure 7) was performed to facilitate right hip extensor activity while increasing hip flexor mobility during right total rotation. This intervention was progressed to right rotations in side lying with 2.2 pound medicine ball full arc arm sweeps to address the loss of total trunk rotation identified on the Selective Functional Movement Assessment and to facilitate scapulothoracic and scapulohumeral coordination in a gravity-assisted movement pattern. Deep squats were also performed with the heels elevated on a 2" x 4" board and with the arms elevated (Figure 8). Despite having an initial shoulder AROM flexion of 30° the patient's active elevation achieved greater than 30° of flexion when asked to perform a deep squat with the upper extremities elevated. This intervention was performed with the heels elevated on a 2" x 4" board during the deep squat to improve performance while maintaining optimal knee and spine posture during an isometric upper extremity activity. Within 2 months, 3 pound weights were added for isometric load overhead during deep squats.

The patient was given comprehensive verbal and written instructions and agreed to return to physical therapy when each exercise could be successfully performed for 10 repetitions and the home exercise program could be progressed.

OUTCOMES

At the 4-month follow-up, after a total of 8 physical therapy visits, the patient reported decreased frequency of right shoulder soreness with activities. Activities of daily living, particularly eating and dressing, were reported to be improved to satisfactory levels. The patient reported a noticeable increase in cervical mobility with decreased stiffness. However, he noted minimal soreness in the region of the right acromioclavicular joint with increased right upper extremity activity. The Disabilities of the Arm, Shoulder and Hand (DASH) score following physical therapy improved to 34.2/100, as compared 48.3 initially, indicating a change of 14.1. In a recent study, a DASH score change of 15 has been sug-

Figure 5. Right tandem stance with arms overhead.

Figure 6. Toe touch with heels elevated on 2"x 4" board.

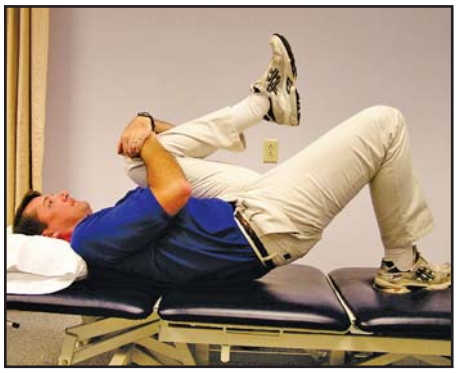

Figure 7. Passive lock and lift.

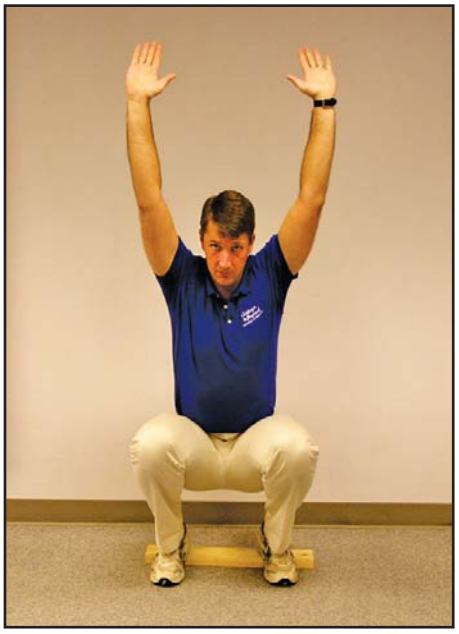

Figure 8. Deep squat with heels elevated on 2"x 4" board.

gested to discriminate between improved and unimproved patients.[42] The patient was extremely pleased with the level of functional return of the right upper extremity and improvement in general mobility, especially as compared with his level of skepticism prior to beginning physical therapy.

The postural examination revealed decreased forward head posture and upper thoracic kyphosis with improved right scapular position. Right shoulder active range of motion of flexion improved to 0° – 140° without pain, abduction was 0°-90°, and internal rotation to T12. Results for passive range of motion of the right shoulder were within normal limits and pain free for all motions. Manual Muscle Testing was not performed based on the outcome of the Selective Functional Movement Assessment. These results are outlined in Table 2.

Considerable improvement was noted on the Selective Functional Movement Assessment with minimal pain only reported on the active right shoulder impingement test. Improvement on the hurdle stance was evident by the minimal compensation necessary to maintain single leg stance. These findings demonstrated considerable improvement in most movements, especially those associated with pain on the initial Selective Functional Movement Assessment.

DISCUSSION

This case illustrates the potential for regional interdependence and functional movement assessment of the trunk and legs, including balance, to play a role in the examination of a patient with rotator cuff dysfunction. The Selective Functional Movement Assessment provided a comprehensive movement examination tool that illuminated several dysfunctional movement patterns that helped to guide the patient examination. The dysfunctional movement findings were incorporated into complex intervention strategies, including upper and lower extremities, that allowed this patient to achieve all of his functional outcomes with a chronic rotator cuff tear. Addressing this patient's balance deficit while performing upper extremity activities appeared to contribute considerably to his ability to raise his right arm overhead during the initial visit. Even with considering limitations in single subject study design and measurement criteria, these findings challenge the physical therapist to consider the effect of anticipatory postural control and its influence on voluntary arm movement. Further research needs to be done to identify, standardize, and validate gross measures of function as a guide for developing clinical hypotheses that effectively link to already valid and reliable tests and measures used in a comprehensive physical therapy examination. We recognize that no tool will effectively and efficiently serve all patient populations, neonatal through geriatric, and address all conditions, including postsurgical and limited weight-bearing, without modification.

Examination of the postural alignment and gross movement patterns during physical examination can help the physical therapist when assessing static and dynamic postural control strategies. The *Guide for Physical Therapist Practice* suggests a review of the musculoskeletal and neuromuscular systems, in addition to the cardiovascular/pulmonary and integumentary systems, prior to administering tests and measures to verify or reject diagnostic hypotheses. Horak[43] states that quantitative, norm-referenced tools that assess postural control clinically should include measures that: (1) reflect both the functional capabilities and quality of movements of the postural control system, (2) are both sensitive and selective for postural control abnormalities, (3)

Table 2. Final Selective Functional Movement Assessment

Classification	Movement
Functional and Nonpainful	Left total rotation Left upper extremity impingement (across) Cervical forward bending Right cervical rotation
Functional and Painful	None
Dysfunctional and Nonpainful	Spinal forward bending Spinal backward bending Bilateral spinal side bending Right total rotation Bilateral hurdle stance (single leg stance) Deep squat Bilateral upper extremity pat Bilateral upper extremity scratch Cervical backward bending Left cervical rotation Bilateral cervical side bending
Dysfunctional and Painful	Right upper extremity impingement (across)

Functional – unlimited or unrestricted movement[26]
Nonpainful – no reproduction or increase in symptoms
Dysfunctional – movements that are limited or restricted in some way demonstrating a lack of mobility, stability, or symmetry within a given functional movement[26]
Painful – reproduces or increases symptoms, or brings about secondary symptoms that need to be noted[26]

are reliable and valid, and (4) are practical for the practicing physical therapist and that posture control is complex and cannot be evaluated with any one global measure of "balance." The Selective Functional Movement Assessment integrates many of the components of the musculoskeletal and neuromuscular systems review that coincided with important postural control strategies in this case. It has been adopted as a form of a musculoskeletal/neuromuscular systems review with most of the patient examinations in our physical therapy practice.

The patient in this study demonstrated increased balance stability (decreased postural sway), increased right upper extremity elevation, decreased right shoulder pain with elevation, and improved cervicothoracic postural alignment while in tandem stance with repeated arm raising. The improvement in balance stability, upper extremity elevation, and postural alignment could correlate positively with improved postural control during repeated perturbation.

The intervention program used in this case provided encouragement to the patient during the initial physical therapy visit. The patient experienced an increased awareness of movement and balance limitations. The immediate improvement in right shoulder function without pain while performing the interventions provided positive feedback to the patient.

Following 4 months of physical therapy without surgical intervention, this patient was able to attain all his personal functional goals, perform active forward shoulder flexion to 140°, and display noticeable improvement on the Selective Functional Movement Assessment for all 3 upper extremity movements without pain. Moderate improvement was documented on the DASH questionnaire. In addition to improved right shoulder function with activity, he reported noticeable improvement in cervical mobility with daily activities. Prior to beginning physical therapy he had experienced chronic cervical stiffness. Other than the postural control interventions that were performed, there had been no interventions performed directly related to cervical mobility. This improvement in cervical mobility was attributed to improved postural control strategies and decreased scapulohumeral dysfunction.

Based on this patient's clinical and radiographic presentation, the likelihood for successful functional outcome was poor without surgery. The assessment of this patient's balance and gross movement limitations provided invaluable information for formulating interventions based on postural control strategies. The successful outcomes in this case warrant further exploration of the relationship between balance, postural control, and shoulder function in a patient with chronic rotator cuff pathology.

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Appendix A. Selective Functional Movement Assessment[26]

Forward Bending (toe touch maneuver)
Backward Bending (overhead reaching with spine extension)
Standing Rotation (head, shoulder, and pelvic rotation)
Single Leg Stance (postural muscle response)
Deep Squat (heels flat with shoulders flexed)
Shoulder Pattern Extremes (back scratch, hand behind head, active horizontal adduction)
Cervical Spine Pattern Extremes (flexion, extension, rotation)

The Q-Score: A Valid and Reliable Test for Grading Quadriceps Contraction

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ABSTRACT

Background and Purpose: Inhibition of the quadriceps muscle is a phenomenon commonly observed in the presence of knee pathology. Evaluation of quadriceps contraction is an objective measure that should be assessed. While many clinicians grade the quality of the quadriceps contraction, there exists no scale that has been proven reliable or valid. Our purpose was to design a grading scale that can be used by physical therapists as a reliable and valid method to assess quadriceps contraction. **Methods:** Thirty patients performed an isometric quadriceps contraction in supine position with a Pressure Cuff Stabilizer© under the knee. Physical therapists graded the contraction based on visual and manual inspection using a scale devised by the authors. The amount of pressure generated in the Pressure Cuff Stabilizer© was also documented and the two values were compared. **Findings:** Spearmans correlation ranged from 0.49 to 0.68 indicating there is a correlation between the grade given by physical therapists and the amount of pressure generated in the Pressure Cuff Stabilizer©. The inter-rater reliability of the grade varied from moderate agreement to substantial agreement. The grading scale appears to be a valid measurement of the amount of force generated in the quadriceps. There is strong inter-rater reliability among the physical therapists that used the scale to measure quadriceps contraction. **Clinical Relevance:** The grading scale presented is an easily administered clinical evaluation tool to measure the quality of an isometric quadriceps contraction in patients with knee pathology. The scale is valid and reliable.

Key Words: knee, quadriceps, inhibition, contraction

INTRODUCTION

Inhibition of the quadriceps muscle is a phenomenon that is commonly observed in the presence of knee pathology. Physical therapists and physicians often see obvious muscle inhibition, or inability to fully contract the quadriceps muscle, in patients with knee injury or knee pain. The reasons for quadriceps inhibition may include joint effusion, ligamentous laxity, muscle weakness, and trauma.[1-3] Arthrogenic muscle inhibition (AMI) is a presynaptic, ongoing reflex inhibition of a joint after distension or damage to that joint.[2] Arthrogenic muscle inhibition is a natural mechanism designed to protect an injured joint.[2] Inhibition of the quadriceps muscle can be observed by incomplete contraction of the muscle with voluntary control. Inhibition of the quadriceps can lead to disuse atrophy and decreased neuromuscular control.[1,2] Atrophy of the quadriceps muscle can further lead to changes in the biomechanical alignment, increase ligamentous stress, and impede the rehabilitation process.[1-3] It is common within physical therapy practice for clinicians to grade the quality of the quadriceps muscle contraction when evaluating patients with knee pathology. Different levels of ability to contract are often observed. Some patients are able to contract the entire quadriceps while others are unable to voluntarily completely contract the quadriceps muscle. As neuromuscular control and strength improve, the patient's quality of quadriceps contraction is visibly improved. Evaluation of the quality of quadriceps contraction is an objective measure that should be assessed on initial evaluation and at subsequent reassessment to monitor patient progress. After completing an extensive literature review, we found that, although many clinicians grade the quality of the quadriceps contraction, there exists no scale that has been proven reliable or valid. Our goal for this study was to design a scale that can be used by physical therapists as a reliable and valid grading system to assess the quality of the quadriceps contraction.

The investigators hypothesize that physical therapists will be able to reliably use a clinical grading scale to measure the quality of an isometric quadriceps contraction in patients with knee pathology. This scale will also be shown to be a valid measure of quadriceps muscle contraction.

This is an easily administered clinical evaluation tool. If it is proven to be reliable and valid, it can be used by physical therapists while performing evaluations and subsequent re-evaluations to document patient progress, for assessment of treatment efficacy, and possibly for reimbursement documentation and research data collection.

METHODS

Thirty patients presenting to our Sports Physical Therapy and Performance Center with knee related diagnoses were recruited to participate in the study. Patients with a variety of diagnoses took part in this study (Table 1). This study was approved by the Institutional Review Board at Hospital for Special Surgery. Informed consent was obtained. Inclusion criteria were English speaking patients presenting with a physician referral for physical therapy who had a diagnosis of knee pathology. Exclusion criteria were any patient whose knee pathology would preclude them from performing a quadriceps isometric exercise or any patient that has complained of local or

Table 1. List of Patient Diagnoses

1	PCL tear
1	Microfracture knee
5	ACL tear
7	PFPS
5	ACL Reconstruction
1	Lateral Release
3	Proximal and Distal Realignment
2	ORIF Tibia
2	TKR
2	Pes Anserine Bursitis
1	Partial Medial Meniscectomy
30	Total

Figure 1. Stabilizer© Pressure Biofeedback cuff.

referred pain during the quadriceps contraction. Although patients had varying degrees of edema, any patient who was unable to reach full active extension of their knee was excluded.

The patient was asked to lie supine on the exam table. A small inflatable Stabilizer© Pressure Biofeedback cuff (Chattanooga, TN) (Figure 1) was placed under the knee and inflated to 40 mmHg. This is the starting point for cuff inflation that has been reported in the literature for testing of abdominal muscles.[9,10] Inflation to this level also allowed the heavier limbs to remain in slight knee flexion and was comfortable for the patients. The cuff was positioned so the middle of the cuff was centered with respect to the medial tibial-femoral joint line. The patient was asked to "press the back of the knee down into the cuff and tighten the knee muscle as much as possible." The patient was instructed to have their heel remain in contact with the exam table throughout the maneuver and the patient was observed for substitution of hip extension for knee extension (Figure 2). While the patient performed this quadriceps isometric contraction, the therapist placed his/her fingers on the quadriceps muscle to palpate the contraction and to observe the contraction visually. The therapist then graded the contraction based on a scale of 0 to 3 (Table 2). This is a grading scale developed by the authors to describe the amount of contraction that is observed in the quadriceps muscle. The grading scale was termed the "Q-Score."

The Q-Score grade was recorded on a data collection sheet by the grading therapist. The Stabilizer© Pressure Biofeedback (SPB) cuff under the patient's knee, when compressed, causes a movement of the measurement needle in response to the amount of pressure applied. While the patient was performing the quadriceps contraction, the amount of movement of the needle (above the preset 40 mmHg) of the SPB cuff was documented by the primary investigator (RM). The grading therapist was blinded to the measurement reading on the SPB cuff. This procedure was repeated for 30 patients.

Reliability

This procedure was repeated by a minimum of 4 different physical therapists from a pool of 8 physical therapists that were blinded to the Q-Score grades given by the other therapists. We performed a Kappa and Intra-class Correlation Coefficients (ICC) to confirm reliability between therapists. We also compared experienced (8+ years experience) versus less experienced (< 8 years experience) raters separately to see if there was an experience effect. The Kappa categorization proposed by Landis & Koch were applied to these values.[8]

Validity

When the patient contracts the quadriceps muscle and puts pressure on the inflatable pressure cuff of the SPB, the amount of pressure produced (mmHg) can be read on the dial attached. This value was recorded by the primary investigator and later compared to the Q-Score scores given by each physical therapist. We ran a Bland-Altman validity test to determine the validity of this study. A Spearman Rank Correlation was calculated to determine the validity of the grading scale in estimating the quadriceps activation by comparing the subjective therapist's grade with the objective SPB measurements.

RESULTS

Correlation between SPB cuff measurement and the Q-Score grade given by the physical therapist (absent, poor, fair, or good) Spearman's correlation ranged from 0.49 to 0.69 indicating that there is a positive correlation between the two variables. All were statistically significant ($p < 0.01$). Cuff values ranged between 4 and 56 mmHG. The inter-rater ICC for the SPB cuff variable was 0.976 (95% CI 0.959, 0.988). This is highly statistically significant (p value < 0.001) and represents extremely high correlation with regard to reliability of the measurement. The kappa statistics for the inter-rater reliability of the Q-Score variable ranged from 0.345 (moderate agreement) to 0.729 (substantial agreement) (Table 3).

We further investigated if there was a difference in the Q-Score grades given by more experienced physical therapists and those with less experience. Physical therapists with 8 years or greater of clinical practice were categorized as 'experienced' and those with less than 8 years of clinical experience were categorized as 'inexperienced.' Both experienced and inexperienced raters had 'moderate' to 'substantial' agreement with the exception of one pairing of experienced raters that had 'slight' agreement.

DISCUSSION

The Q-Score grading scale appears to be a valid measurement of the amount of force generated in the quadriceps. The grades given by therapists were correlated with the amount of pressure generated in the SPB cuff (Spearman's correlation 0.49 to 0.69).

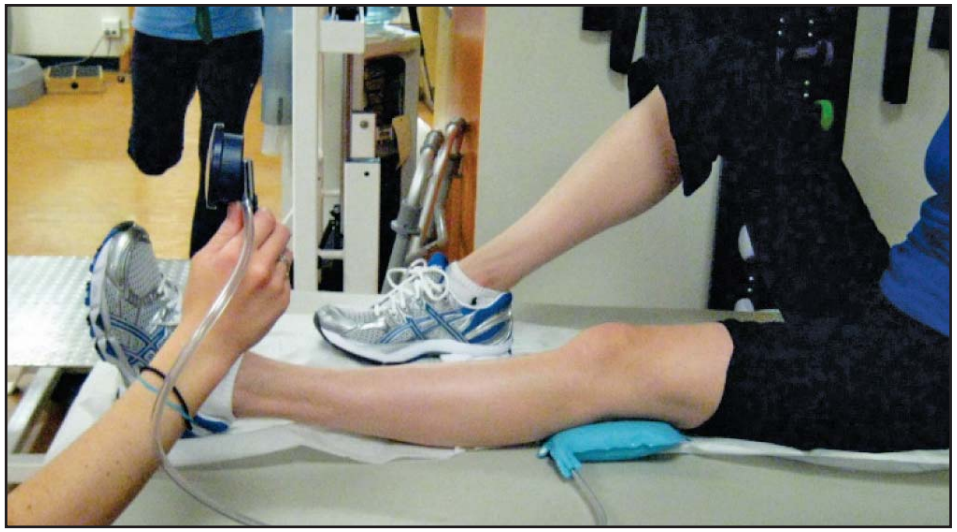

Figure 2. Positioning for measurement of quadriceps contraction with Stabilizer© Pressure Biofeedback cuff.

The inter-rater reliability of the Q-Score grade variable varied from moderate agreement to substantial agreement. There was moderate agreement when the therapist had to decide between a grade of poor or fair. There was greater agreement when deciding between fair or good grades. There is excellent agreement when the therapist had to decide between a grade of absent and poor and substantial agreement when deciding between the grades of absent and good.

There does not appear to be an appreciable experience effect based on the criteria of how we defined the two rater groups. If anything, the experienced raters may be a little less reliable between each other. This lack of experience effect is, for practical purposes, good. This implies that very inexperienced clinicians can use the scale and there is not necessarily a learning curve based on years of clinical practice. The Q-Score grading system can be used by inexperienced users with accuracy.

The SPB cuff has been used by other investigators to test strength in locations such as the abdominal muscles and our results appear to suggest it can be used to measure quadriceps strength as well. Richardson et al used the SPB cuff to correctly identify strength deficits of the transversus abdominis muscles in patients with low back pain.[7] Hemingway et al has used the SPB cuff to test the strength of the abdominals in patients who had undergone repair of abdominal wall disruption.[8]

LIMITATIONS

There were no subjects who were graded as "absent." This is a function of the randomness of the order of patients presenting for therapy. It is also due to the relatively rare appearance of the complete lack of ability to contract the quadriceps. This situation may present after femoral nerve block for pain management or injury to the femoral nerve. We did not have any subjects in the current study that fell into this group. Another limitation is that we did not use EMG on the quadriceps to get a comparable measure of activation to supplement the visual and pressure readings. We could have, additionally, palpated hip extensors to make sure they were not being recruited to assist with knee extension.

CONCLUSION

The grading scale presented in this study is an easily administered clinical evaluation tool that can be used to measure the quality of an isometric quadriceps contraction in patients with knee pathology. The Q-Score has been demonstrated to be reliable and valid. It can be used by physical therapists while performing evaluations and subsequent re-evaluations to document patient progress, for assessment of treatment efficacy, for reimbursement documentation, and research data collection.

Table 2. Quadriceps Scoring Grades

Grade	Level	Description
0	Absent	No contraction.
1	Poor	Ability to engage some of the quadriceps muscle with minimal contraction.
2	Fair	Ability to engage the majority of the quadriceps muscle with moderately tight contraction.
3	Good	Ability to engage the entire quadriceps muscle with tight contraction.

Table 3. Kappa Values for Inter-rater Reliability of Assignment of Grade Using Clinical Grading Scale for Quadriceps Contraction

Comparison	All Therapists	Experienced	Inexperienced
(absent to poor):	0.595 ± 0.122	0.471 ± 0.145	0.639 ± 0.132
(absent to fair):	0.522 ± 0.133	0.733 ± 0.134	0.515 ± 0.166
(absent to good):	0.729 ± 0.110	--	--
(poor to fair):	0.345 ± 0.136	0.151 ± 0.160	0.412 ± 0.181
(poor to good):	0.440 ± 0.130	--	--
(fair to good):	0.551 ± 0.137	--	--

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Orthopaedic Section, APTA, Inc.

Combined Sections Meeting 2011

Preconference Courses

Tuesday, February 8th & Wednesday, February 9th, 2011

Tuesday, February 8, 2011 (1-day course)

Move It and Move On: Integrating Manual Therapy and Functional Rehab of the Shoulder Girdle

DESCRIPTION: This lab-intensive course is designed to serve as the link between selected manual therapy interventions and functional rehabilitation of the shoulder girdle. Manual therapy techniques, both thrust and non-thrust, will be presented targeting the thoracic spine and shoulder. Strategies for exercise intervention will highlight the regional interdependence between the shoulder girdle and the rest of the kinetic chain. Selected case studies will demonstrate the effective integration of manual therapy and functional exercise techniques.

OBJECTIVES: Upon completion of this course, you will be able to:

1. Incorporate self-report measures, history, and physical examination based on evidence from the literature into clinical decision-making; 2. Demonstrate clinical examination skills for the thoracic spine and shoulder girdle; 3. Demonstrate manual therapy and exercise intervention strategies based on the diagnosis and current evidence for patients/clients with thoracic spine and shoulder disorders; 4. Describe therapeutic exercise strategies based on movement impairments of the shoulder girdle and kinetic chain.

SPEAKERS: Robert Boyles, PT, DSc, OCS, FAAOMPT; Danny J. McMillian, PT, DSc, OCS, CSCS
LEVEL: Intermediate

Wednesday, February 9, 2011 (1-day course)

Orthopaedic Manual Physical Therapy for the Lower Extremity: Evidence, Evaluation, and Intervention

DESCRIPTION: A progressive hands-on course with emphasis on clinical skills for in-depth manual examination and treatment of osteoarthritis (OA) in the lower extremity. The focus will be on the hip and knee; however, associated management of the entire lower extremity will be included. The speakers have been actively engaged in this line of clinical research for 15 years. The current evidence regarding OMPT for individuals with lower extremity OA will be presented, followed by a laboratory session with hands-on instruction in OMPT evaluation and treatment techniques. Upon completion, participants will be familiar with the body of evidence for manual physical therapy, feel comfortable with an advanced competency manual examination (differing from a diagnostic orthopaedic examination), and make precise intervention decisions with minimal risk to patients. Participants will be able to reinforce clinical treatment with exercise programs designed by manual physical therapists based on best evidence and targeted to relevant impairments identified through the manual examination. All techniques presented have been selected from high quality published physical therapy research, some of which the presenters have contributed to, and continue to use in their current clinical research and practice.

OBJECTIVES: Upon completion of this course, you will be able to:

1. Be familiar with the current state of the evidence regarding OMPT management of individuals with hip or knee OA; 2. Be able to compare the strength of the evidence for OMPT against other nonsurgical and surgical interventions; 3. Be familiar with a basic and advanced skill-set of OMPT examination techniques of the lower extremity for individuals with hip or knee OA; 4. Be familiar with a basic and advanced skill-set of thrust and non-thrust mobilization/manipulation techniques for individuals with hip or knee OA; 5: Be familiar with clinical decision-making strategies used in OMPT management of patients with hip or knee OA.

SPEAKERS: Gail Deyle, PT, DSc, DPT, OCS, FAAOMPT; Skip Gill, PT, DSc, OCS, Cert. MDT, FAAOMPT; Ben Hando, PT, DSc, OCS, FAAOMPT ; Daniel Rhon, PT, DPT, DSc, OCS, FAAOMPT
LEVEL: Intermediate

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Combined Sections Meeting 2011 * Preconference Courses (cont.)

Tuesday, February 8th - Wednesday, February 9th, 2011

Tuesday & Wednesday, February 8 – 9, 2011 (1 ½ day course)

Placing Physical Therapists at the Center of Fitness, Health Promotion, and Wellness

DESCRIPTION: Part 1 will present the public health context and necessity of PTs taking a central role in fitness, health promotion, and wellness. Part 2 will present case studies of the PT fitness intervention for under-exercisers with and without co-morbidities. Part 3 will discuss the importance of specificity of exercise prescription. Part 4 will present large and small scale models of integrating fitness into physical therapy practice in a way that is cost effective and beneficial to society.

OBJECTIVES: Upon completion of this course, you will be able to:
1. Participants will correctly identify the public health context, rationale and evidence for physical therapists taking a central role in fitness and health promotion; 2. Participants will correctly identify the knowledge, skills, and abilities required to conduct a credible physical therapist-based fitness assessment; 3. Participants will be able to apply fitness-based tests and measures to an under-exercising patient population with and without co-morbidities; 4. Participants will be able to distinguish between general exercise recommendations and specific exercise prescription to meet their patient's needs; 5. Participants will be able to implement specific program planning for a fitness-focused venture in their own market, as well as analyze the analyze the return on investment and the net revenue generating potential of implementing physical therapist-based fitness programs.

SPEAKERS: Carl DeRosa, PT, PhD; Jennifer Gamboa, DPT, OCS, MTC; Reed Humphrey, PT, PhD; Steve Tepper, PT, PhD
LEVEL: Intermediate

Tuesday & Wednesday, February 8 – 9, 2011 (2-day course)

Tai Chi Fundamentals® Program Professional Training Seminar Levels One and Two: Applications for Therapeutic Exercise, Wellness, and Function

DESCRIPTION: In this 2-day course, participants learn the 12 Movement Patterns of the Tai Chi Fundamentals® (TCF) Program, and their seated adaptations, the first section of the TCF form, and the movements of the Seated ROM Dance®. Course combines lecture, movement labs, biomechanics, applications, and documentation. Tai Chi movement is introduced in a [illegible] development progression integrating mind/body exercise components into instruction, including breathing, sensory awareness, and visualization. Includes applications as therapeutic assessment and intervention tools. Course qualifies for APTA CEUs and provides contact hours fulfillment for TCF Instructor Certification Levels One and Two. NOTE: Certification requires 30 [illegible] hours, additional fees, written and movement exams.

— CANCELLED —

OBJECTIVES: Upon completion of this course you will be able to:
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SPEAKERS: Kristi Hallisy, PT, MS, OCS, CMPT, CTI; Tricia Yu, MA
LEVEL: Multiple

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Non-Mbr	$450	$475	$500
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The Use of Thoracic Mobilization for Neck Pain: A Case Report

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ABSTRACT

Background and Purpose: Neck pain is commonly treated in physical therapy. Manipulation to the thoracic spine is a common intervention for neck pain; however, it is unclear if mobilization to this region can be as effective as manipulation. The purpose of this case report is to describe the use of thoracic mobilization as a physical therapy intervention for neck pain. **Case Description:** A 54-year-old male presented with an insidious onset of acute neck pain. Significant limitations of range of motion were present, particularly left rotation. Radicular symptoms were not present. The patient was classified as having a "mobility" impairment. Treatment intervention included cervicothoracic junction and thoracic mobilizations. **Outcomes:** There were significant improvements in range of motion and function in 4 visits of physical therapy. The patient reported no pain and 95% improvement. **Discussion:** This case report supports the use of thoracic mobilization in treatment of a patient with "mobility" classified neck pain. Without a control, no direct comparison to manipulation can be made.

Key Words: neck pain, mobilization, manipulation, physical therapy

BACKGROUND

Physical therapy is often part of nonoperative management of neck pain with various causes. Patients with a primary diagnosis of neck pain may comprise up to 16% of outpatient physical therapy referrals.[1] Despite the frequency of physical therapy treatment for patients with neck pain, there is debate regarding effectiveness of common physical therapy interventions for neck pain. The Philadelphia Panel[2] could not find evidence to include or exclude the following treatments due to a lack of research: thermotherapy, therapeutic massage, EMG feedback, mechanical traction, therapeutic ultrasound, and electrical stimulation. The use of therapeutic exercise was supported for chronic neck pain. Manual therapy, including mobilization and manipulation, was not addressed in the guidelines; however, it has gained attention in recent research.[3-7]

Fritz and Brennan[3] proposed a physical therapy treatment-based classification system for patients with neck pain to guide therapists toward effective and evidence-based intervention. An algorithm is used to classify patients into one of 5 treatment groups: mobility, centralization, exercise and conditioning, pain control, and headache. Patients who fit into the "mobility" classification are those who have not had a motor vehicle accident or other high velocity induced cervical strain, have no nerve compression signs or symptoms distal to the elbow, do not have a chief complaint of headaches, have had symptoms less than 30 days, and are less than 60 years old. Treatment recommendations for this classification include cervical or thoracic mobilization or manipulation and strengthening of the deep neck flexor muscles.[3] The treatment guidelines do not include reasoning for manual therapy of the thoracic spine versus the cervical spine nor reasoning to choose manipulation versus mobilization.

There are several considerations to contemplate when choosing manual therapy interventions. A cerebrovascular accident (CVA) is a rare but serious risk with cervical spine manipulation. The cause of CVA with administration of a manipulation technique is dissection of the vertebrobasilar artery.[8] Although the true incidence of CVA with cervical spine manipulation is unknown,[8,9] there are 117 cases in the literature dating back to 1934.[8] Screening tests for potential vertebral artery insufficiency have not been shown to be sensitive or specific for identifying those at risk during manipulation.[9] Haldeman et al[8] reviewed 64 cases in which a CVA occurred after cervical manipulation. In 27 of the 64 cases, the practitioner recorded screening for the vertebral artery through both the history and positioning the head in rotation and extension. All 27 cases indicated negative results. With a lack of definitive screening tests and a lack of data on the true incidence of CVA following cervical manipulation, the risks of vertebral artery trauma associated with cervical manipulation are somewhat unclear.[9]

There is a biomechanical link between the cervical and thoracic spine. Recent research supports the use of thoracic manipulation for acute neck pain.[4,5] Cleland and Childs[6] proposed a clinical prediction rule for the use of thoracic manipulation with neck pain. They cite 6 criteria: symptoms less than 30 days, no symptoms distal to the shoulder, symptoms do not increase with looking up, a Fear Avoidance Beliefs Questionnaire (Physical Activity subscale) score of less than 12, decreased upper thoracic kyphosis, and cervical extension less than 30°. The success rate of manipulation increases with the number of criteria met; 3 out of 6 criteria is attributable to 86% success and 4 out of 6 to 93% success.

Despite the fact that thoracic spine manipulation poses less risk to the patient, all side effects may not be eliminated. Cagnie et al[10] assessed outcomes of manipulation of all regions of the spine. Sixty-one percent of patients reported at least one side effect including: headaches, stiffness, increased complaints of pain, radiating discomfort, and fatigue. Twenty-six percent reported impaired activities of daily living (ADLs). Of those reporting side effects, 67% reported resolution within 48 hours. Of the side effects, only headache, dizziness, and nausea were most likely to occur with manipulation of the cervical spine. Thus, side effects must be considered as a possibility with manipulation of any region of the spine.

Only one randomized, controlled study has considered the influence of thoracic spine mobilization versus manipulation in patients with neck pain. Cleland et al[7] found manipulation to be superior to mobilization for decreasing neck pain and dysfunction. However, there were limitations to this study. Only short-term (2-4 days) outcomes were assessed. Also, the mobilizations consisted of posterior-anterior (PA) mobilizations in prone; other techniques were not considered.

Clearly, the thoracic spine deserves attention as a possible contributor to neck pain, specifically those who meet the clinical prediction criteria for thoracic manipulation. However, it is unclear if mobilizations can be as effective as manipulation in treatment.

The purpose of this case report is to describe a patient that fit the "mobility" classification for physical therapy intervention of neck pain and the use of thoracic mobilizations as a component of physical therapy treatment.

CASE DESCRIPTION

History

Patient K was a 54-year-old male referred to physical therapy by his primary care physician with a prescription for "neck pain, evaluate and treat." He complained of neck pain that began while he was walking into work approximately one week prior. With no clear etiology, Patient K felt his neck stiffen, and he was unable to turn his head to the left. He noted he had not worked since that day secondary to his pain. In addition, driving was difficult because of the lack of mobility in his neck. His goal was to be pain free with all activities. He was scheduled to return to work the next day.

Patient K described his pain as a constant ache, rated at a 6/10 on a visual analog scale; his pain became sharp, rated at 8/10, with movement. The pain was centrally located with mild radiation into his left upper trapezius (UT), and symptoms increased late in the day. He denied numbness or tingling or pain with a cough or sneeze. No headaches or dizziness were reported. Although it was initially difficult to move his left arm, Patient K was able to complete most ADLs if he did not move his neck. He had not found anything to relieve his symptoms.

Patient K's job required physical labor assembling office furniture. His past medical history included low back pain, treated successfully by physical therapy several months prior, and diabetes. No medical red flags were identified. Radiographs were not taken.

Examination

During the first observation of Patient K, the physical therapist noted a mildly overweight man sitting with a typical "slouched" posture: moderate decreased lumbar lordosis, mild increased thoracic kyphosis, and moderate forward head. Cervical active range of motion (AROM) was measured with a single inclinometer as this method has demonstrated good reliability.[11] Patient K had significant limitation and pain with left rotation and left sidebending. Table 1 displays the recorded cervical AROM measurements. Shoulder AROM was within normal limits, though he complained of mild pain with left shoulder abduction. Upon manual muscle testing, all upper extremity muscles tested 5/5, with the exception of the left shoulder abduction and shoulder flexion which both tested 4/5.

Table 1. Cervical Active Range of Motion Measurements

Cervical Motion	Examination	Final Visit
Extension	30°	31°
Flexion	35°	47°
Left Rotation	25°	52°
Right Rotation	47°	64°
Left Sidebending	12°	35°
Right Sidebending	23°	39°

In screening for neurological involvement, sensation to light touch was intact throughout the upper extremities. The upper limb tension test (ULTT) was negative. The ULTT has high sensitivity at 97% providing good reason to rule out a cervical radiculopathy.[12] Cervical compression in sitting increased central pain and pressure but produced no radicular symptoms; distraction "relieved pressure" according to the patient. Palpation revealed tenderness to the left UT. Segmental motion testing[13] revealed decreased left rotation at C7-T1 and T1-2. Spring testing[13] revealed hypomobility at T3 and T4. No further testing was completed at this time to avoid further aggravation of Patient K's symptoms.

Diagnosis

The following problems were identified: decreased lower cervical and upper thoracic joint mobility, decreased left upper extremity strength, soft tissue impairment, and functional deficits including difficulty driving and inability to work. Patient K was identified as matching the "mobility" classification for neck pain[3] as he had no mechanism of injury, no nerve root compression or symptoms distal to the elbow, no complaints of headaches, had symptoms with an onset of less than 30 days ago, and was under the age of 60. The physical therapy practice pattern identified was 4F: "Impaired joint mobility, motor function, muscle performance, range of motion, and reflex integrity associated with spinal disorders."[14]

Prognosis

Patient K was a motivated individual in generally good health with a strong desire to return to work. He had no prior episodes of neck pain. With symptom onset one week ago, rehabilitation potential was considered good. Practice pattern 4F recommends 8 to 24 visits.[14] Due to the recent onset of symptoms and lack of other confounding medical issues, the therapist recommended 4 to 8 visits. Functional goals included complete resolution of symptoms with driving and return to work without limitation.

Intervention

Treatment was initiated on the first visit with a goal of reducing Patient K's pain and increasing cervical AROM, specifically left rotation. Supine manual cervical traction was initiated at a Grade II to decrease pain with progression to Grade III to increase ROM.[13] Gentle soft tissue mobilization (STM) was directed at the left UT to decrease guarding during mobilization. Initial specific mobilization was directed at the C7-T1 level as limited mobility had been found during assessment, and it was the therapist's experience that mobilizations directed at this level frequently subsided UT pain. Mobilizations with movement (MWM), as described by Mulligan,[15] were directed at C7-T1 left rotation. Patient K was able to turn his head further without increased symptoms during the treatment; however, the results did not carry over to AROM following the technique. Thus, seated manual mobilizations of C7-T1, as described by Lee[16] were performed. Only mild improvements were noted; therefore, treatment then was directed at the second area of limitation, the thoracic spine. Patient K met 4 of 6 criteria for the Clinical Prediction Rule for thoracic manipulation;[6] however, the therapist was at a disadvantage in size for performing a supine manipulation and was not comfortable attempting

Figure 1. Thoracic extension self-mobilization with a towel.

it. Consequently, prone PA glides using bilateral transverse processes were directed at T2-6 with a Grade III to increase ROM. Significant increase in cervical left rotation with decreased symptoms followed. Based on the success of treatment aimed at the thoracic spine, the initial home exercise program (HEP) included supine self-mobilization over a towel for thoracic extension (Figure 1) and supine cervical AROM into left rotation to elicit gains in ROM. Both exercises were to be completed 2 to 3 times per day in a pain-free manner. Table 2 further outlines treatment per visit.

Returning for his second visit 2 days later, Patient K stated his neck was still "a little stiff" but was definitely improved. He reported he no longer experienced sharp pain and could turn his head further to the left. A warm-up on the upper extremity bicycle ergometer (UBE) was initiated to facilitate blood flow and pliability of the tissues. Upon reassessment, the UT was moderately tender, C7-T1 left rotation was decreased, and the midthoracic spine was generally hypomobile into extension. Prone thoracic PA glides again were used due to the success of the previous visit. Grade III C7-T1 left rotation mobilizations were performed in supine using contact with the laminae bilaterally (Figure 2). This was followed up by passive range of motion (PROM) of the cervical spine into left rotation. Seated thoracic mobilizations[13] (Figure 3) were aimed at the mid-thoracic spine to more aggressively mobilize this region. The patient subjectively noted that this mobilization seemed very effective. Following the combination of mobilizations, the therapist noted near full AROM with no complaints of pain. A thoracic extension self-mobilization over a chair (Figure 4) was added to the HEP to more aggressively treat the thoracic spine.

At the beginning of visit 3, 5 days later, Patient K noted his neck felt normal "for a few days" following the last treatment. He noted that his only complaint that day was mild pain into the left UT with turning his head to the left. Mobilizations during this day did not vary from the previous due to their success. However, the HEP at this point gave no attention to the C-T junction. Therefore, the therapist instructed Patient K in a self-mobilization using a towel, as described by Mulligan.[15] The therapist also instructed the patient in proper posture as the kyphotic nature of his posture, thereby positioning the thoracic spine in flexion, may have contributed toward the inability to extend the thoracic spine.

At the final visit, the therapist reassessed Patient K. No changes were made in manual therapy techniques; however, cervical retraction with active cervical/thoracic extension was added to the HEP as the patient wanted to learn an additional technique to maintain his gains in AROM.

Table 2. Physical Therapy Interventions

Visit #	Active Warm-up	Manual Therapy Intervention	HEP	Total Treatment Time
1		• Supine manual cervical traction, Grade II & III. • Gentle soft tissue mobilization (STM) to the L UT. • Seated MWM, ext @ C7-T1 sets of 5, and L rotation 5x • Seated manual mobilization C7-T1, L rotation, Grade III • Prone thoracic PA mobilization T2-6, Grade III	• Self thoracic extension mobilization over towel, 10x • Supine AROM, L rotation 5-10x	25 minutes
2	UBE, forward and backward revolutions, 3	• Prone thoracic PA mobilization T3-7, Grade III • Gentle STM to left UT & gentle stretching • Supine C7-T1 rotation, Grade III, followed by PROM • Seated mid- thoracic extension mobilizations, Grade III	• Seated active thoracic extension in chair with collar grip, 5-10x	25 minutes
3	UBE, forward and backward revolutions, 4-5 minutes	• Manual traction, Grade III • STM to left UT and stretching (3 x 30 seconds) • Supine C7-T1 rotation, Grade III, followed by PROM • Seated thoracic extension mobilizations, Grade III	• Self mobilization with towel for left rotation (Mulligan), 3-5x • Postural education	35 minutes
4	UBE, forward and backward revolutions, 4-5 minutes	• Manual traction, Grade III • STM to left UT and stretching • Supine C7-T1 rotation, Grade III, followed by PROM • Seated thoracic extension mobilizations, Grade III • Prone thoracic PA mobilization T3-7, Grade III	• Cervical Retraction with active extension, 3 sets of 5	30 minutes

Outcomes

At his final visit, Patient K reported 95% improvement overall. He rated his pain at 0/10 with reports of occasional mild stiffness. All goals of the patient were met, and he could turn his head to drive without difficulty and had returned to work without limitation. Patient K stated he was very happy with the outcome. Final measurements using an inclinometer were as follows. Cervical AROM had improved by

Figure 2. Supine C7-T1 left rotation mobilization.

Figure 3. Extension mobilization of the thoracic spine.

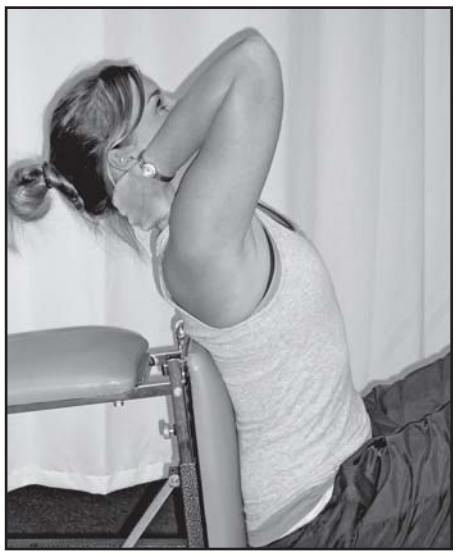

Figure 4. Thoracic extension self-mobilization over a chair.

23° for left sidebending and 27° for left rotation. Flexion improved by 12°, right rotation by 17°, and right sidebending by 16°. There were no complaints of pain with AROM. Specific measurements are shown in Table 1. Left shoulder abduction and flexion manual muscle tested at 5/5. Tenderness to the left upper trapezius resolved. The only remaining findings were a mild decrease in extension and left rotation at C7-T1 and T1-2 per segmental motion testing.

DISCUSSION

Previous research[6-8,10] supports the use of thoracic manipulation for physical therapy patients with neck pain that meet specific clinical prediction criteria. A single study[7] did not support the use of thoracic mobilizations in place of manipulation; however, this study had limitations. Only short-term outcomes were assessed, and the only type of mobilization used was a PA glide. The purpose of this case report was to describe a patient that fit the "mobility" classification for physical therapy intervention of neck pain and the use of thoracic mobilizations as a component of physical therapy treatment.

Fritz and Brennan[3] provide a useful treatment-based classification scheme for patients with neck pain. Patient K logically fit in the "mobility" classification; therefore, manual therapy was considered an appropriate intervention. Upon evaluation of Patient K, the primary limitation of motion was identified at the C7-T1 level. Treatment directed at this level was only mildly successful; therefore, the thoracic spine was addressed due to its link in the kinetic chain. Although the patient met 4 of 6 criteria for the Clinical Prediction Rule for thoracic manipulation,[6] the therapist was at a disadvantage in size and was not comfortable in attempting a manipulation. Thus, thoracic mobilizations were implemented. The PA mobilizations of the thoracic spine increased cervical AROM, but mild limitation was still present. As an attempt to more aggressively treat the thoracic spine, seated mobilizations were implemented. This allowed for a combination of passive thoracic extension with the mobilization force. C7-T1 mobilizations were continued each treatment due to the palpable loss of motion at this segment and the mild improvements made during the first treatment.

It appears the use of thoracic mobilizations to treat neck pain was successful in a patient with neck pain identified as fitting the "mobility" classification and who met 4 out of 6 clinical prediction criteria for thoracic manipulation. This is in contrast to the randomized control trial by Cleland et al.[5] However, there are differences in this case report that may have contributed to the success of the mobilizations. The follow-up was greater than 4 days, PA glides were not the only mobilization used, and treatment progressions, including a HEP, were made based on results. In addition, the mean duration of symptoms in the study by Cleland, et al[5] was 55 to 56 days with a large standard deviation. The patient in this case study had symptoms for only 7 days. The clinical prediction criteria for thoracic manipulation with neck pain include symptoms existing less than 30 days.[6] If these criteria can potentially be applied for the use of mobilization and not just manipulation, then the recent onset of symptoms may have increased the potential for success in this patient as compared to the patients in the Cleland et al study.

There are limitations to this case study. There was no long-term follow up with the patient. Since more than one type of thoracic mobilization was used, one cannot discern which mobilization was more effective. Additional mobilizations directed at C7-T1 appeared to have a mild impact on Patient K's AROM. Also, posture instruction and the HEP may have impacted the final outcome. It is possible that Patient K may have improved more quickly with manipulation than mobilization. Finally, this case study cannot be generalized to all patients with neck pain.

CONCLUSION

This case report supports the use of thoracic mobilization in treatment of a patient with "mobility" classified neck pain. Further studies are needed to compare thoracic mobilization and manipulation in patients with neck pain. Different types of mobilizations and the impact of posture and home exercises using self-mobilization techniques also need to be assessed.

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The Use of Cold Laser in Conjunction with Traction and Lumbar Extension Exercises for Treatment of Lumbar Disc Herniation: Case Report

Khaled Temraz, PT, DPT

This manuscript was completed in partial fulfillment of the author's DPT.

ABSTRACT

Background and Purpose: Over 95% of lumbar disc herniation (LDH) occurs at the L4-5 or L5-S1 levels. There is limited research to support the management of LDH using the cold laser combined with lumbar extension exercises and traction. The purpose of this case study was to discuss the use of cold laser in conjunction with lumbar extension exercises and mechanical lumbar traction to treat patients with acute low back pain (LBP) caused by LDH. **Case Description:** The patient was a 36-year-old male referred to physical therapy with a medical diagnosis of herniated disc at L4-L5 with compression of the L4 nerve root confirmed by MRI. The patient's main complaint was pain over the right lumbosacral area with radiating pain into the right thigh and right lower leg. **Intervention:** The treatment protocol was divided into 3 phases: Phase 1 (visit 1-6) included lumbar extension exercises and mechanical lumbar traction. Phase 2 (visit 7-18) included lumbar extension exercises and mechanical lumbar traction in conjunction with cold laser therapy. Phase 3 (visit 19-21) included back stabilization exercises and patient education 1 visit/week for 3 weeks. **Outcomes:** The patient was seen for a total of 21visits. The Minimal Detectable Change (MDC) was used to interpret the outcome measures and showed meaningful improvement changes in pain and function. **Conclusions:** The data from this case study shows that using cold laser combined with lumbar extension exercises and mechanical traction appears to be an effective treatment approach for this patient with acute LBP caused by LDH.

Key Words: lumbar disc herniation, cold laser, lumbar extension exercises, mechanical traction

INTRODUCTION

Low back pain (LBP) is a common musculoskeletal disorder associated with a considerable social and economic burden within the working-age population.[1] The causes of low back pain may include muscle strain, tendonitis, herniated disc, and facet dysfunction.[2] Physical therapy treatment for acute LBP caused by lumbar disc herniation (LDH) can include education, exercises, and traction, as well as modalities such as heat, ice, thermal ultrasonography, electrical stimulation, and laser. Studies show that physical therapy treatment including back exercises, traction, and cold laser produced a moderate reduction in pain and improvement in function in patients with acute LBP caused by LDH.[3,4] The same studies recommended that further research is warranted on treatment for acute LBP. The purpose of this case study is to describe the effect of the cold laser in conjunction with mechanical traction and lumbar extension exercises for a patient with acute LBP caused by LDH.

BACKGROUND

Lumbar extension exercise is one of the physical therapy techniques that are used in the treatment of acute LBP caused by LDH. Lumbar extension exercises are used for its pain relief effect and not as strengthening exercises. Luciana and colleagues stated in their studies "With the McKenzie approach exercise is not used to strengthen the back muscles, but to promote rapid symptom relief."[5] Studies have shown that lumbar extension causes an anterior migration of nuclear tissue, and reduces pain by decreasing the forces acting on pain sensitive tissue.[3] The anterior migration of the nuclear tissue that results from lumbar extension has been the basis for the use of lumbar directional movements, especially lumbar extension during rehabilitation to reduce LBP. Two meta-analyses regarding the McKenzie method of physical therapy indicated that the McKenzie method is more effective than other treatments for acute LBP patients.[6,7] A multicenter randomized controlled trial study that was conducted between September 2005 and June 2008 concluded that, the McKenzie method does not produce appreciable improvements in pain, disability, and function.[5] Even though the debate continues over the effectiveness of the McKenzie method; it continues to show immediate reduction in low back pain intensity following lumbar joint mobilization and prone press-ups. Twenty patients with back pain who received extension mobilizations and extension in lying were monitored with MRI before and after, and classified as responders if there was a reduction in pain score of 2 or more. Responders demonstrated a mean increase in diffusion coefficient in the middle portion of the disc compared to a mean decrease in the non-responders.[8]

Traction is one of the physical techniques that are used by the physical therapist for the treatment of the patient with acute LBP associated with radicular symptoms and neurological deficit due to LDH.[9] Correctly performed traction produces reduction in the size of the herniation, increases space within the spinal canal, widens the neural foramina, and decreases thickness of the psoas muscle.[10] Lumbar traction is both effective in improving symptoms and clinical findings in patients with LDH and also in decreasing the size of the herniated disc material as measured by computed tomography (CT) scan.[11] In a single-blind randomized clinical trial comparing interventions for patients with LBP with signs of radiculopathy, 64 patients (mean age 41.1 year, 56.3% female) with LBP, leg pain, and signs of nerve root compression were randomized to receive a 6-week extension-oriented intervention with or without mechanical traction during the first 2 weeks. The study concluded a subgroup of patients likely to benefit from mechanical traction may exist.[12] The Cochrane systematic review concluded, "traction probably is not effective," also pointed out that "we lack strong, consistent evidence regarding the use of traction due to the lack of high quality studies, the heterogeneity of study populations, and lack of power."[13]

Cold laser has been shown to reduce

inflammation and promote healing in disc herniation. Studies have demonstrated that laser therapy is effective in reducing prostaglandin concentrations and demonstrating that inflammation is greatly reduced 75, 90, and 105 minutes after active laser therapy compared to levels prior to treatment.[14] The reduction in inflammation appears to be another method by which laser therapy promotes healing in disc herniation.[15] Another study examined the effectiveness of laser therapy in treating LDH measured by clinical evaluation and magnetic resonance imaging (MRI).The study included 60 patients (18 men and 42 women) with a mean age of 44.5 years (range, 20-60 years) who presented with acute LBP and leg pain that was definitely diagnosed as being caused by LDH. The results found that laser therapy is effective in the treatment of patients with acute LDH, and repeated MRI scans provide evidence of morphological regression of herniated disc mass.[4] A randomized, double-blind, placebo-controlled trial was performed on 546 patients. The study was carried out between January 2005 and September 2008. Group A (182 patients) were treated with nimesulide 200mg/day and additionally with active laser; group B (182 patients) was treated only with nimesulide; and group C (182 patients) was treated with nimesulide and placebo laser. Treatment of acute LBP with radiculopathy at 904nm laser at a dose of 3 J-point, proposed as additional therapy to nonsteroidal anti-inflammatory COX-2 drugs, has shown better improvement in local movements, more significant reduction in pain intensity and related disability, and improvement in quality of life, compared with patients treated only with drugs and a placebo laser procedure, and with no side effects. The results of this study show better improvement in acute LBP treated with laser used as additional therapy.[16] In contrast, the Cochrane study concluded that there is insufficient data to either support or refute the effectiveness of laser therapy for low back pain.[17] There is not enough evidence supporting the use of laser therapy in conjunction with both lumbar extension exercises and mechanical traction for the management of acute LBP caused by LDH.

CASE DESCRIPTION

Patient History

A 36-year-old, male was referred to outpatient physical therapy for evaluation and treatment with a diagnosis of a low back pain secondary to herniated disc at L4-L5. The MRI confirmed a far-lateral disc herniation at the L4-L5 and compression of the L4 nerve root. The patient's employment requires repetitive lifting, bending, twisting, driving, and moving heavy equipments and tools on a regular basis throughout the work day. Onset of the condition was described as immediate back pain and spasm after attempting to catch a heavy object falling from a counter. The symptoms became worse with pain extended over the right lumbosacral and central lumbar region, radiating pain into the right thigh, and numbness and tingling in the right lower leg down to the foot. The patient was referred to physical therapy 2 weeks after the onset of pain. The patient's main goals were to return to work and be able to participate in recreational drumming without pain. On evaluation, the patient's symptoms were described as increased when bending, leaning forward, and when arising from the seat. His symptoms decreased when standing, lying prone or supine, and walking downhill. The patient's medical history included history of back pain but subsided by rest and over-the-counter pain relief. No significant medical history or surgery was reported.

Table 1. Patient's Initial and Subsequent Outcome Measures Using: Spine Range of Motion, the Back Pain Functional Scale (BPFS), the Oswestry Low Back Pain Disability Questionnaire (ODQ), and the Numerical Pain Rating Scale (NPRS)

Visit	Lumbar Range of Motion Forward Bending (FB)	Lumbar Range of Motion Backward Bending (BB)	The Back Pain Functional Scale (BPFS)	Patient score (ODQ)	Pain Level (NPRS)
Initial visit	25 °	15 °	15/60	64%	8-9/10
Visit 3	28 °	18 °	-	56%	7-8/10
Visit 6	30 °	20 °	26/60	48%	6-7/10
Visit 9	45 °	25 °	-	30%	3-4/10
Visit 12	50 °	28 °	48/60	16%	1-2/10
Visit 15	55 °	30 °	-	8%	0-1/10
Visit 18	60 °	30 °	56/60	4%	0/10
Discharge visit	60 °	30 °	58/60	0%	0/10

Physical Examination

Structural observation

The patient is of mesomorph intermediate build with forward head and rounded shoulders, and a flat back posture. The right shoulder appeared slightly dropped. No other deformities or asymmetries were observed.

Palpation in standing

The patient has tenderness on the right lumbar region more at the level L4-5, increased muscle tone on the right side (spasm/guarding). The right iliac crest and right posterior superior iliac spine were slightly higher than left. The skin temperature was warmer to touch in the right lumbar region.

Palpation in prone

Tenderness over L4-5 was present. The muscle tone (spasm/guarding) decreased on the right side. A trigger point was palpated on the lateral-superior margin of the right quadratus lumborum just below T12 rib.

Active motion assessment

Active range of motion was within the normal limit for both upper and lower extremities. Goniometric range of motion measurements of the spine were taken in standing using an inclinometer. To measure the forward and backward bending, the inclinometer base was placed on the T12 spinous process in the sagittal plane, and to measure the side bending and rotation, the inclinometer was placed in the frontal plane on T12 spinous process. Intrarater reliability for forward flexion is (.84–.79); intrarater reliability for backward bending is (.74–.60).[18] Patient's forward bending was 25/60°, backward bending was 15/30°, and side-bending range to the right, to the left, and rotation were within normal limits.

Manual muscle testing

Manual muscle testing was performed to measure the muscle strength of bilateral lower and upper extremities, back, and abdominal muscle. Right hip flexors, right

knee extensors, ankle dorsiflexors, and great toe extensors scored 4/5. Abdominal and back muscles scored 3/5. Upper extremities and left lower extremity scored 5/5.[19]

The L4 right knee jerk reflex

The L4 right knee jerk reflex was sluggish (diminished /hyporeflexia) with score of 1out of 4, while the left side was normal. The ankle jerk reflex was normal in both ankles.[20]

Femoral nerve stretch test

The femoral nerve stretch test is used for the diagnosis of mid-lumbar impingement or compression on the L2, L3, and L4 nerve roots and has been shown to be reliable. The patient was positioned in prone on the table with the knee flexed to 90°. The right hip was passively extended by lifting the right thigh off the table.[21] The test was positive, patient expressed irritation, and radicular pain in the anterior thigh rather than a mild feeling of tightness.

Centralization

Centralization is the situation in which referred pain arising from the spine is reduced and transferred to a more central position when movements in specific directions are performed (McKenzie assessment).[22] The patient reported that repeated back bending (extension) 10 times produced significant decrease in pain and tingling sensation. Lumbar flexion increased radicular pain to right leg.

Outcome measures

The Oswestry Low Back Pain Disability Questionnaire (ODQ), the Back Pain Functional Scale (BPFS), the Numerical Pain Rating Scale (NPRS), and the spine range of motion were used to measure and assess pain and dysfunction. The Oswestry Disability Questionnaire is used to measure the patient's permanent functional disability and has shown to be a valid and reliable test in assessing pain related disability in persons with low back pain; the Oswestry has an internal consistency of 0.82–0.90 and a test-retest reliability of 0.88–0.94, higher scores represents more severe disability.[23] The NPRS is a self-report tool to assess pain intensity; the NPRS has test-retest reliability from 0.67–0.96. The patient is asked to describe his pain on a scale of 0–10, 0 being no pain and 10 being the worst pain.[24] The back pain functional scale (BPFS) is used to evaluate functional ability in patients with back pain; the test-retest reliability 0.88 internal consistency 0.93, the total BPFS scores can vary from 0 (the lowest functional level) to 60 (the highest functional level).[25] The spinal range of motion was measured using the inclinometer, which is a tool that objectively measures the spinal range of motion in degrees. Patient's initial and subsequent range of motion measurements are shown in Table 1.

ASSESSMENT

The patient's medical diagnosis was confirmed by MRI. Based on initial diagnosis of far-lateral disc herniation at the level of L4-L5 and compression of L4 nerve root, the patient's history, and clinical findings the following were determined to be the patient's main impairments and limitations:

- Pain in the lumbosacral region, radiating pain, numbness, tingling and squeezing to right thigh, lower leg and foot, rated 8-9/10.
- Weakness; the right hip flexors, knee extensors, ankle dorsiflexors, great toe extensors scored 4/5 abdominal and back muscle scored 3/5.
- ROM; lumbar spine forward bending was 25° backward bending was 15°.
- Sitting without a back support (on a stool/bench) was limited only for 15minutes (for example limited sitting to watch his kid's soccer games).
- Dressing; limited for upper and lower extremity includes putting his shoes and socks on.
- Driving; limited for short distance increase pain and radiating pain with increase distance and vibration, in and out of the car aggravate pain.
- Walking; was limited to 10 minutes then pain and squeezing increase in the thigh and lower leg.

The centralization phenomenon, supported by examination findings as reported by the patient decreased his radicular pain after repeat back extension 10 times. The patient was classified by McKenzie's classification (postural, derangement and dysfunction syndrome) as lumbar spine derangement syndrome.[22] Browder et al support the belief that patients who centralize with extension movements during examination may preferentially benefit from a treatment approach focused on repeated extension movements.[26]

PROGNOSIS

The natural history of back pain is favorable; studies showed that 30% to 60% of patients recover in one week, 60% to 90% recover in 6 weeks, and 95% recover in 12 weeks.[27] Patient's age, motivation, prior level of function and improvement with the repeated back extension are factors contributing positively to the prognosis. Based on the medical diagnosis, physical therapy finding, and clinical experiences, the patient scheduled for physical therapy treatment 3 times per week for 6 weeks and 3 follow up visits once per week for 3 weeks. Pain and function reassessment were scheduled every 3 visits.

INTERVENTION

The treatment protocol was divided into 3 phases. Phase I (severe disability & radiculopathy) included lumbar extension exercises and mechanical lumbar traction 3 times per week for 2 weeks (visit 1-6). Phase II (moderate disability & centralization) included application of cold laser in conjunction with lumbar extension exercise and traction 3 times per week for 4 weeks (visit

Table 2. Phase 1 Intervention Visit (1-6): The Application of Lumbar Extension Exercises and Mechanical Lumbar Traction 3/week x 2 weeks

Intervention	Visit 1-3	Visit 4-6
Prone extension on elbow	2 minutes	2 minutes
Prone pushups until full elbow extension	3 sets of 10x	3 sets of 10x
Traction type	Continuous	Continuous
Traction position	Prone	Prone
Traction force	85 lb	85 lb
Traction duration	15 minutes	20 minutes
Traction followed by:		
Prone press ups	10 x	10 x
Back extension in standing	3 sets of 10x - 2-3 sec. hold	3 sets of 10x - 5-10 sec. hold

7-18). Phase III (minimal disability & stabilization) 3 follow up visits included back stabilization exercises and patient education for home exercises program once per week for 3 weeks (visit 19-21). The goals of the treatment protocol for phase I, II, and III were: decrease the effect of herniated disc over L4 nerve root, reduce pain through reduction of edema and inflammations associated with the herniated disc, and accelerate the process of healing, and build muscle strength to stabilize the lumbar region and prevent re-injury. In phase I as shown in Table 2, the repetitive lumbar extension exercises as designed by McKenzie were selected to centralize the patient's radicular pain. The lumbar extension exercises included extension while prone on elbow and hold for 2 minutes, then pushes up slowly till extending the elbows. Prone press-ups repeated 3 sets of 10. The mechanical continuous lumbar traction was applied in the first visit for 15 to 20 minutes; the patient was lying in prone position with a pillow under his pelvis for comfort. The intensity of the lumbar traction force (85 lb) was selected to be 40% to 60% of the patient's total body weight (170 lb).[12] Following the traction, the patient performed repeated prone press-ups 10 times, extension in standing (back-bending and hold the bending for 2-3 sec, then return to the starting position) 3 sets of 10. The patient was educated to perform spinal extension exercises at home every 4 to 5 hours. He was also taught modified resting positions (for sitting and standing) and work postures that will maintain centralization and avoid peripheralization. At the end of Phase I, patient made clinical and functional improvements in all areas. Patient's ROM increased 5° in both forward and backward bending. Radicular pain and tingling sensation were centralized. Patient's disability level improved from severe disability (64%) to moderate disability (48%) on ODQ. Even thought patient's pain was decreased from 8-9/10 to 6-7/10, pain remained to be the patient's main problem that interfered and affected his daily living activities. Since the back pain was still considered in the acute stage, application of cold laser as a physical therapy modality and an additional intervention was considered.

Phase II, began in the seventh through eighteenth visit and included the application of cold laser over lumbar region in conjunction with lumbar extension exercise and traction. Laser device, laser diodes Gallium-Aluminum-Arsenide (GaAIAs), the laser diode emitting a wavelength of 875nm, and 3 diodes emitting a wavelength of 660nm, maximum power of 625mW, dose 6 J/cm. One minute treatment was applied over interspinous spaces at level L3 - 4 - 5 and S1 (from 2 to 3 cm laterally of the spinous process par vertebral for each point). The patient positioned in prone position for continuous lumbar traction using 90lb traction force for 20 minutes. Cold laser was applied at same time of traction. Traction and laser were followed by repeated prone press-ups, and extension in standing as shown in Table 3. At the end of Phase II and after the application of cold laser in conjunction with lumbar extension and traction for 12 visits, patient's rate of improvement has increased significantly in all areas. Patient has pain free ROM in all directions. Patient's disability level improved from moderate disability (48%) to minimal disability (4%) on ODQ. Since patient was ready to return to his prior level of function, starting Phase III was necessary to improve lumbar stabilization, strength, and prevent re-injury.

Table 3. Phase II Intervention Visit (7-18): The Application of Cold Laser in Conjunction With Lumbar Extension Exercise and Traction

Intervention	Visit 7-9	Visit 10-12	Visit 13-15	Visit 16-18
Prone extension on elbow	2 minutes	2 minutes	2 minutes	2 minutes
Prone full elbow extension pushups	3 sets -15x	3 sets -15x	3 sets -15x	3 sets -15x
Traction type	Continuous	Intermittent	Intermittent	Intermittent
Traction force	85 lb	85 lb	90 lb	90 lb
Traction position	Prone	Prone	Prone	Prone
Traction duration	20 minutes	20 minutes	20 minutes	20 minutes
Application of laser during traction:				
Laser dose	6 J/cm^2	6 J/cm^2	6 J/cm^2	6 J/cm^2
Laser interspinous level of application	L3-4-5-S1	L3-4-5-S1	L3-4-5-4-S1	L3-4-5-S1
Laser duration	I minutes	1 minute	1.5 minute	1.5 minute
Traction and laser followed by:				
Prone press ups	10 x	10 x	15x	15x
Back extension in standing	3 sets of 10x -10-15 sec. hold	3 sets of 10x -10-15 sec. hold	3 sets of 10x -10-15 sec. hold	3 sets of 10x -10-15 sec. hold

Phase III (3 visits once/week for 3 weeks) included stabilization exercises and patient education for home exercises program. Back stabilization exercises included prone gluteal squeezes with alternate arm and leg raises, kneeling stabilization (double knee –single knee). Abdominal exercise for transverses abdominals included abdominal bracing, bracing with bridging supine, bracing with walking, and supine pelvic bracing. Exercises for erector spinae/multifidus included quadruped alternate arm and leg lifts with bracing. Exercises for quadratus lumborum included side support with knees flexed-side support with knees extended. Exercises for oblique abdominals included side support with knees flexed-side support with knees extended. All exercises were repeated 30 repetitions with an 8-second hold. Pain and dysfunction was reassessed in the ninth, twelfth, fifteenth, eighteenth, and discharge visits as seen in Table 1.

OUTCOMES

The ODQ, the NPRS, BPFS and the spine range of motion were used to measures and assess pain and dysfunction throughout treatment course. The patient made significant clinical and functional improvements in all areas (Table 1, Table 4). Patient's muscle strength (measured with manual muscle test) in the right hip flexors, right knee extensors, ankle dorsiflexors, and great toe extensors was 5/5. Abdominal and back muscles muscle strength was 4+/5. The L4 right knee jerk reflex and Femoral Nerve Stretch Test were negative. At the discharge visit, patient reported that he achieved all of his goals. The patient was able to sit, stand, and drive his car for over 30 minutes without pain as compared to 10 to 15 minutes in the initial visit. The patient returned to his job full-time and was able to participate in recreational drumming without pain. The standard error of measurement (SEM) and the Minimal Detectable Change (MDC) were used to interpret the outcome measures and showed meaningful improvement changes as shown in Table 4. The SEM and MDC90 provide (90% confident) that a true change in pain and function occurs

Table 4. Minimum Detectable Change for NPRS, ODQ, and BPFS, FB, and BB

Outcome Measures		Initial Visit	Discharge Visit	Mean/SD	SEM	MDC90
ODQ		64%	0%	32.3 (24.06)	5.89	13.76
BPFS		15/60	58/60	40.6 (19.126)	6.63	15.46
NPRS		8-9/10	0/10	5.2 (3.3)	1.48	3.45
Spinal ROM	FB	25 °	60 °	44.13(14.55)	5.82	13.58
	BB	15 °	30 °	24.5(6.05)	3.08	7.20

The Standard Error of Measurement (SEM) and the Minimal Detectable Change (MDC), the Standard Deviation (SD)

Table 5. Patient's Rate of Progress Before and After Using Cold Laser: Measured by Oswestry Low Back Pain Disability Questionnaire (ODQ); Numerical Pain Rating Scale (NPRS); Back Pain Functional Scale (BPFS); Forward Bending (FB) and Backward Bending (BB)

	Rate of progress after 6 visits using extension exercises and traction	Rate of progress after 6 visits using cold laser, extension exercises, and traction
ODQ	16%	32%
BPFS	18.33%	36.60%
NPRS	20%	50%
FB	8.4%	33.3%
BB	16.60%	26.67%

after physical therapy treatment.[25,28] Standard errors of measurement calculated using the following equation (SEM = SD x [1- $\sqrt{r}$]). In this equation, SD is the standard deviation of the measure, and *r* is the reliability coefficient (test-retest reliability). Minimal detectable change scores were calculated at the 90% confidence interval. The formula used for calculating MDC_{90} was (MDC_{90} = SEM x 1.65 x$\sqrt{2}$). To show true changes in the patient's function (BPFS) the outcome needs to increase by at least15.46, if the change in function is ≤15.46, then the change is likely due to error in the measurement and not a true change in function ability. The study conducted by Elaine et al stated, the MDC for the ODQ was 16.7 points, and for the NRS is 2.4 points.[29] The study conducted by Ostelo et al stated "for a range of commonly used back pain outcome measures a 30% change from baseline may be considered clinically meaningful improvement when comparing before and after measures for individual patients."30 Comparing the patient's BPFS, ODQ, NPRs scores in the initial visit to the discharge visit, the patient scores improved by 43 points on BPFS, 64% on ODQ, and 9 points on NPRs as shown in Table 4.

DISCUSSION

Over 95% of lumbar disc herniation occurs at the L4-5 or L5-S1 levels.[20] Physical therapy treatments for patient with acute LBP caused by LDH can include various interventions. Supported by studies and evidences each treatment intervention individually had benefits in the treatment of acute LBP. More research is needed to support that the combination between intervention and modalities with specific parameters can maximize benefits and accelerate the process of recovery. In this case study, the combination of lumbar extension exercises, mechanical traction, and cold laser therapy was more beneficial to treat the patient and improve the recovery. The patient responded to lumbar extension exercises and traction by experiencing centralization of pain with repeated and sustained back bending during phase I (visit 1-6) of physical therapy treatment. Even thought the patient demonstrated an improvement on ODQ, BPFS, NPRS, and spine range of motion as showed in (Table 1), the pain remained the patient's main problem and affected all of his activities of daily living. The study conducted by Fritz et al suggested that a subgroup of patients likely to benefit from mechanical traction may exist. It also suggested that extending the duration of traction treatment beyond 2 weeks may be beneficial and future research should examine additional parameters to optimize the effectiveness of traction.[12] The patient required more aggressive intervention to improve the pain and functional level after reviewing the outcome measures from phase I. In phase II, the application of cold laser as an additional physical therapy modality was begun. Although cold laser remains questionable in its effect for treatment of LDH, the studies conducted by Unlu et al, Lim et al, and Konstantinovic et al demonstrated that cold laser had anti-inflammatory and anti-edematous action owing to its influence in reducing prostaglandin synthesis. In particular, its inhibitive effect on prostacyclin has been reported to provide pain and inflammation regression as well as decreasing the size of herniated disc mass. There were significant reductions in the size of the herniated mass on MRI after laser treatment.[4,15,16] The reassessment of pain and function after using the cold laser for 6 visits indicated significant improvement of pain and function (Table 5). For example, the patient scored on ODQ dropped from 48% to 16%. The patient improved from severe disability to minimal disability and he was able to cope with most of his daily living activities. The patient's rate of progress continued to improve significantly in all aspects supported by follow up measures on ODQ, BPFS, NPS, and spine range of motions as showed in Figure 1. The lumbar stabilization exercises to target the spinal extensor muscles, multifidus, abdominals, and obliques were chosen for the patient supported by clinical experience as preventive measures from reoccurrence. Based on the meaningful changes in the all outcomes with the patient in this case study, the use of cold laser in conjunction of lumbar extension exercises and traction for the treatment of acute LBP caused by LDH may be a viable way to improve and accelerate recovery. Even though the use of cold laser in conjunction with traction and lumbar extension exercises showed meaningful changes in all the outcomes in the treatment of lumbar disc herniation in this case study, further research is needed to make definitive treatment recommendations.

There is a lack of research regarding the effect of cold laser combined with lumbar extension in the treatment of lumbar disc herniation. A single case report cannot prove

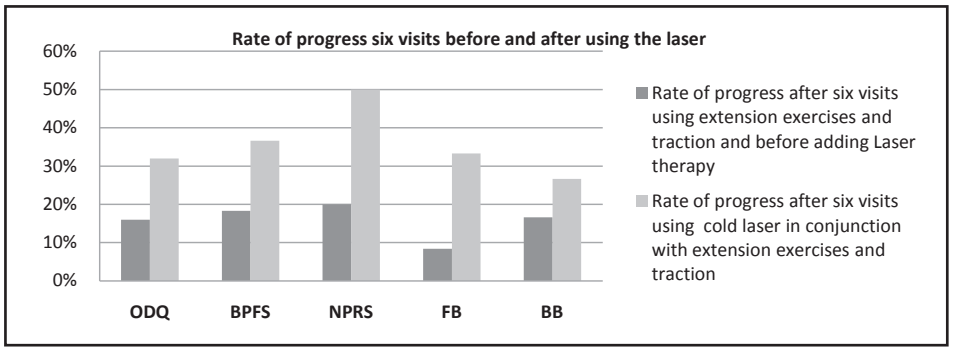

Figure 1. The rate of the patient progress before and after using laser therapy.

that the use of cold laser therapy in conjunction with lumbar extension and traction as described in this case study is actually what created and caused the achieved result, only statistical analysis of a larger treatment group, compared to a clearly defined control group can do that. This case study can only provide the basis for more definitive research.

CONCLUSION

In this case study, the use of cold laser therapy in conjunction with lumbar extension exercises and mechanical lumbar traction appears to be a beneficial intervention to reduce pain and improve function for patients with acute low back pain caused by lumbar disc herniation. The outcome measures in this case study showed meaningful changes in all measures. According to the literature, there is scientific evidence that each treatment intervention individually is effective in the treatment of acute low back pain caused by lumbar disc herniation. There is currently a lack of research regarding the effects of this combined treatment regimen. Further research with a large patient population is needed to evaluate the effectiveness of cold laser therapy in conjunction with lumbar extension exercises and mechanical lumbar traction in the treatment of patients with acute lumbar disc herniation.

ACKNOWLEDGEMENTS

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(continued on page 48)

Finance Committee Report

Steven R. Clark, PT, MHS, OCS
Chairman

The Finance Committee met in August to review financial operations and to make recommendations for the 2011 budget. The Gillette & Associates audit of the 2009 Section income/expenses has ascertained that Section operations and its cash flow is in conformity with accepted accounting principles through December 31, 2009.

AUDIT REPORT 2009
STATEMENT OF ACTIVITY
Years Ended December 31, 2009 and 2008

	2009	2008
UNRESTRICTED NET ASSETS		
Unrestricted Revenues, Gains, Losses		
Membership dues	702,462	706,763
Registration, meetings	578,839	566,785
Advertising income	43,922	44,609
Shipping and handling income	22,693	23,736
Publishing and administrative	55,192	54,802
Sale of promotional items	1,943	1,606
Miscellaneous	11,605	10,381
Investment income	48,989	86,501
Rental income	49,277	52,585
Sale of assets	(24,257)	(12,055)
Total Revenue	1,490,665.00	1,535,713.00
Less: Administrative Expenses	(273,308)	(323,618)
Program Expenses	(1,121,771)	(1,047,298)
Add: Unrealized Gain (loss) on Investments	314,621	(579,692)
Change in Unrestricted Net Assets	410,207	(414,895)
Net Assets at Beginning of Year	2,604,881	3,019,776
Net Assets at End of Year	$3,015,088	$2,604,881

MARKETABLE SECURITIES	**FAIR MARKET VALUE**		
	2008	2009	10/01/2010
LPL Investment Reserve	$524,846	$804,834	$897,740
Wells Fargo - Research, Practice and Education Fund	$757,369	$959,339	$1,080,740

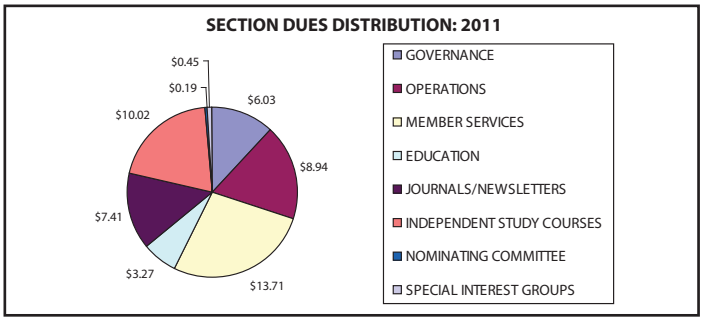
The 2009 audit demonstrates an increase in net assets from 2008 of $410,207. This increase is reflective in the positive market returns for 2009 - LPL Reserve Fund ($279,988) and the Wells Fargo Research, Practice and Education ($201,970). In addition Terri DeFlorian, Executive Director and the Section staff should be commended on their ability to reduce administrative expenses by $50,310.

The following operating budget for fiscal year 2011 has been approved by the Section Board of Directors.

2011 OPERATING BUDGET

	2011 Proposed Expenses	2011 Proposed Income
GOVERNANCE	$180,005	$47,403
OPERATIONS	$266,778	$52,199
MEMBER SERVICES	$409,120	$702,000
EDUCATION	$97,671	$209,370
JOURNALS/NEWSLETTERS	$221,082	$151,645
INDEPENDENT STUDY COURSES	$299,796	$328,985
NOMINATING COMMITTEE	$5,550.00	$0.00
OCCUPATIONAL HEALTH SIG	$2,500.00	$0.00
FOOT AND ANKLE SIG	$2,500.00	$0.00
PAIN MANAGEMENT SIG	$2,500.00	$0.00
PERFORMING ARTS SIG	$2,500.00	$0.00
ANIMAL REHABILITTION SIG	$2,500.00	$0.00
	$1,492,502	$1,491,602

This budget will allow the Section to continue offering membership dues at the $50.00 level signifying no increase in dues since 1994.



The Board of Directors had an opportunity to sell the land positioned in front of the LaCrosse office location for $346,222 and felt that this was appropriate to allow the Section to have additional dollars should it decide to move forward in building the footprint that has been discussed. At this time, the real estate market in LaCrosse does not support the Section moving forward with further rental property, thus a build out is not recommended. These dollars will be placed in a fund under the management of LPL for future building needs.

The Board of Directors has approved the Finance Committee recommendation of setting up an escrow account for equipment/facility depreciation so that these funds are always accounted for. These dollars will be placed in a fund at LPL which will allow active management based upon upcoming purchase needs.

If you have questions regarding the audit report for 2009 or the 2011 operating budget, feel free to contact me at: Steven@clarkphysicaltherapy.com.

Book Review

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

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

Orthopaedic Manual Therapy Diagnosis: Spine and Temporomandibular Joints, Jones & Bartlett Learning, 2010, $99.95
ISBN: 9780763755942, 578 pages, Hard Cover

Editor: van der El, Aad, BPE, BSc, PT

Description: This is the first English-language edition of a Dutch publication on the assessment of the spine and temporomandibular joints from an orthopedic manual therapy perspective. Although the topic is the subject of other books, this one offers a different perspective, challenging and expanding readers' knowledge. **Purpose:** The purpose is to offer English-language orthopedic manual therapists (OMTs) a thorough system to diagnose and manage patients based on the long history of orthopedic manual therapy that has developed over the years in Europe. **Audience:** OMTs at both the entry level and postgraduate level are the intended audience. The book is certainly appropriate for an OMT with at least a couple of years of experience or more. Because it offers a lot of similar ways to evaluate a patient, practicing clinicians will be able to pull from their current skills to follow the material. However, there are a lot of variations on techniques, additional techniques, and different terminology used to describe specific tests. This is where OMTs' years of experience will assist them as they navigate the book. They will be able to build upon what they have already learned to further enhance and fine tune their skills. This is not to say that this book is inappropriate for an entry-level therapy program, but those students may find some of it overwhelming since they are required to learn about all aspects of physical therapy, not just orthopedic manual therapy. Additionally, with the push for evidence-based medicine, some schools may argue that the ratio of older references to newer ones is a bit too large to use for teaching, especially when other books have a larger number of more recent references. **Features:** The first half of the book provides the foundational framework of anatomy, biomechanics, spinal function, terminology, and theories. The second half covers the examination of the spine and temporomandibular joints (TMJs). Individual chapters on assessment of the neurovascular system, palpation, the pelvis, lumbar spine, thoracic spine, lower and midcervical spine, upper cervical spine, and TMJs appear in this part. The chapters dedicated to the individual sections of the spine are all organized similarly, covering the functional features of the area, muscular influences, motor-sensory relationships, as well as regional, segmental, and instability examinations. All of the examination techniques are presented clearly with patient and therapist position, stabilization, and description of how the technique is performed. Techniques in the weight-bearing and non-weight-bearing positions further enhance the diagnosing abilities of therapists. Pictures, tables, and charts throughout the book assist readers in gaining an understanding of the material. Additionally, there is information on sclerotomes and viscerotomes not commonly found in other orthopedic books and a more detailed assessment of the neurovascular system. Despite all the advantages of this book, it has a few shortcomings. The first, noted above, is the number of older references. The book is very well referenced, but a lot of references date back over 20 years ago. In the age of evidence-based medicine, this can be a less than desirable feature for some. The second is that some diagrams in the TMJ section are labeled in the Dutch format instead of the English format. Readers not familiar with the anatomy of that area may have a harder time understanding what they are looking at. **Assessment:** Overall, however, this is a great contribution to the OMT world. It provides readers with a lot of information about a unique approach to the assessment and management of the spine and TMJs, broadening their perspective.

Michelle Finnegan, DPT, OCS, MTC, FAAOMPT
(Bethesda Physiocare)

Back Pain: The Facts, Oxford University Press, Inc., 2009, $19.95
ISBN: 9780199561070, 134 pages, Soft Cover

Authors: Lee, John; Brook, Suzanne; Daniel, Clare

Description: In this book meant to educate patients with chronic back pain, the emphasis is on self-management and improving understanding of the processes involved in chronic pain. **Purpose:** The purpose is to educate readers about how back pain develops, what medical treatments are available, and how to help themselves. The book meets these objectives, and it will be valuable to patients who have chronic pain issues. **Audience:** Patients with chronic back pain are the intended audience. The book is written to be easily understood by readers with no medical background. The three authors include a physician specializing in pain, a physiotherapist, and a clinical psychologist from the UCL Hospitals NHS Foundation Trust in London. **Features:** The book covers the anatomy of the spine and offers definitions of common maladies. Different medical treatments and professionals who provide them are explained. Self-treatment, including exercise, relaxation techniques, and pacing, is described. Changes in pain levels and effects of chronic pain on home life are discussed. Key points are highlighted and numerous charts are clearly presented. **Assessment:** This well-done book offers practical techniques for patients who are dealing with chronic pain to educate them about their condition and to gain more control.

Jeffrey B Yaver, PT (Kaiser Permanente)

Pocket Orthopaedics: Evidence-Based Survival Guide, Jones & Bartlett Learning, 2010, $34.95
ISBN: 9780763750756, 408 pages, Spiral Cover

Editor: Wong, Michael, DPT, OCS, FAAOMPT

Description: This is a clinical guide outlining the fundamental concepts in contemporary orthopedic physical therapy examination procedures. Predominant structural elements of the 16 chapters

include colorful anatomical images, clinical examination algorithms, and well-organized tables that list recent supporting research articles underneath. **Purpose:** The purpose is to provide new clinicians with a compact, up-to-date, evidence-based clinical guide to refine the orthopedic clinical examination. The book is successful, providing a thorough guide for clinical examination procedures based on the compilation of the most recently published evidence. **Audience:** Students, residents, and new graduates who practice in outpatient orthopedic settings are the intended audience. The editor is a certified orthopedic specialist and a fellow of the American Academy of Orthopedic Manual Therapy. **Features:** This handbook details orthopedic-related research concepts specific to each region. It covers research, medical screening, pain, functional outcome measures, and the spine and peripheral joints. Each chapter uses colorful anatomical pictorials, color photographs of each clinical examination procedure, and treatment-based classification algorithms. Information about the orthopedic examination is presented in table format that lists the related pathophysiology of each region of the body. Clinical examination procedures specific to each orthopedic condition based on the region of the body are provided. Examination procedures are listed to assist clinicians to select the most appropriate examination technique based on the most recent clinical evidence to either rule in or rule out pathophysiological conditions. Multiple, up-to-date references under each table supplement the data. Each pathophysiological condition is presented in table format, detailing the prevalence of the condition, symptoms, related signs, and treatment-based classification and special tests for each one. Sensitivity, specificity, reliability, and the positive and negative likelihood ratios are provided for each of the special tests. One of the strengths of this detailed compilation is the listing of orthopedic-related research under each table. Also notable is the chapter that lists 14 functional outcome tools in a table that provides the specific functional index measure for various regions of the body, including a description of the tool and scoring with the MCID (minimum clinically important difference) where applicable, as well as a page and a half of clinical references to support the functional outcome data. The chapter on pain, however, is disappointing. The information it provides does not contribute significantly to the overall purpose of the book. It briefly covers CRPS (chronic regional pain syndrome) and fibromyalgia, with an algorithm on graded exercise. **Assessment:** This is an excellent resource for students, residents, and new graduates practicing in outpatient orthopedic settings. The information is presented in a format that can be easily accessed in a clinical environment. It covers similar ground as the textbook, Netter's Orthopaedic Clinical Examination: An Evidence-Based Approach, 2nd edition, Cleland and Koppenhaver (Elsevier, 2011).

Kathleen Tierney Geist, PT, DPT
(Emory University School of Medicine)

Imaging Educational Interest Group: Notes of Interest

Doug White, PT, DPT, OCS

The Imaging Educational Interest Group (IEIG) is pleased to sponsor very interesting and clinically relevant programming at the Combined Sections Meeting.

Integrating the American College of Radiology Appropriateness Criteria® for Musculoskeletal Conditions in Physical Therapy Practice

Speakers: Dr. Michael Ross and Dr. Gail Deyle

What should physical therapists know about diagnostic imaging (ie, plain film radiography, magnetic resonance imaging, bone scans, and computed tomography) to facilitate appropriate patient education and management, as well as maximize outcomes? The American College of Radiology (ACR) Appropriateness Criteria for Musculoskeletal Conditions are evidence-based guidelines that can assist physical therapists in making correct decisions about diagnostic imaging. This course will provide physical therapists with an understanding of the ACR Appropriateness Criteria that can be immediately integrated into their clinical practice. The indications and diagnostic utility for different imaging procedures according to the ACR Appropriateness Criteria for the spine and extremities will be described. Through the use of patient case examples, the evidence for the appropriate use of diagnostic imaging according to the ACR Appropriateness Criteria will be provided, as well as how to place imaged pathology into the appropriate clinical context to assist with the evidence-based evaluation and management of the patient. Common pathologies seen on different diagnostic imaging modalities will be discussed. An emphasis of this course will be on clinical decision making principles in an outpatient, direct access physical therapy setting. However, the principles presented will be applicable to any clinical setting.

The IEIG will also be proposing to transition from an Educational Interest Group to a Special Interest Group (SIG). Should this be approved by the Section Board of Directors we will have a larger role with imaging in orthopaedic practice. The purpose of a SIG is to:

1. provide educational programming to the Section membership;
2. serve the Section as an educational & practice resource for Section members;
3. develop and recommend practice standards & terminology;
4. identify changes in legislation, regulation, & reimbursement issues at state and national levels;
5. identify and provide resource people & materials to accurately share practice information and address areas of concern related to the SIG domain with guidance of the Section; and
6. foster credible research within the SIG domain in conjunction with the Section Research Committee to promote both scientific foundation and interdisciplinary study within the SIG domain.

The Orthopaedic Section and the APTA were recently invited to attend a Point-of-Care Ultrasound Forum sponsored by the American Institute of Ultrasound in Medicine (aium). Forty-two professional societies were represented and discussed ultrasound applications in a variety of care and specialty settings. We look forward to a continuing collegial relationship with the aium.

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

GREETINGS AND HAPPY NEW YEAR OHSIG MEMBERS!

I hope you all had a wonderful holiday with your family and friends!

The OHSIG had a very busy 2011 and I am proud of all we accomplished on your behalf. Here is what is ahead for 2011.

ELECTION RESULTS

The OHSIG has a new VP/Ed Chair and Nominating Committee member. The names will be announced at the CSM Business Meeting. We thank these individuals for their willingness to serve, and we look forward to working with you!

CSM NEW ORLEANS, FEB 9-12, 2011

CSM Feb 2011 is just ahead. We hope you have made plans to attend both the OHSIG education session and our Membership Business Meeting. Yes, we know. The Membership Business Meeting is an early morning for all of us---Saturday, Feb 12, 7-8am. But we hope you will come for Continental Breakfast and networking with OHSIG board members and OHSIG members. Our education follows the Membership meeting. We look forward to seeing you in New Orleans! See below for more on the education session.

CSM 2011 UPDATE- "WHAT'S COOKING FOR NEW ORLEANS"

Every Day Excellence in Workers Compensation: Preventing Needless Disability, Peer Review Gems, Guidelines, and Practical Considerations

Although workers compensation is fairly standard for many outpatient payer mixes, providers often note frustration trying to expand their skill set and master the complexities of working with injured workers. In addition to return to work considerations, navigating multiple stakeholder groups including employer, case managers, adjusters, and various state work comp boards can seem overwhelming.

This 3 hour program is designed to help increase physical therapists and physical therapist assistants' comfort and effectiveness in the area of worker rehabilitation. The program covers the latest work rehabilitation guidelines, practice strategies for preventing needless disability, and documentation pearls to quickly and easily demonstrate appropriate care patterns. Learn more about the various stages of a work comp cycle, return to work planning and payment/policy methodologies. Screening criteria for factors that are associated with long term disability and intervention recommendations to improve outcomes/successful return to work will also be included.

Learning Objectives:

1. Describe the course of a workers compensation claim and how to effectively integrate with other health care professionals and stakeholders.
2. Implement strategies to reduce needless work disabilities and recognize "flags" or barriers that can slow care.
3. Implement treatment strategies for progressive return to work goals based on workplace policies and partnering.
4. Identify APTA work rehab/work injury management guidelines (and other stakeholder groups) and understand the use/implications in your practice.
5. Ensure that documentation is adequate for minimizing reimbursement issues by conveying the necessity for professional level care by a physical therapist.

Brief Session Outline:

1. Life of a work comp claim and case management
   Steps, stages, and roles of stakeholders
   Payment methodologies and underlying assumptions
   Blue flags
2. Preventing needless work disability- principles, concepts, and evidence
   What shortens/promotes early RTW vs prolongs/delays RTW
3. Options for progressive/guided RTW
4. Implications for clinical practice set up/equipment
5. Guidelines, documentation, and barriers to recovery

Presenters

John Lowe, PT (Also serves as Moderator)
James Hughes, PT
Chris Juneau, PT, DPT, ATC, EMBA
Nicole B. Matoushek, MPH, PT, CEES, CEAS

HATS OFF TO OUTGOING OHSIG BOARD MEMBERS - DEE DALEY AND JOHN LOWE

- Dee has been an active member of OHSIG for several years. As VP/Ed Chair, she has coordinated OHSIG education at CSM. She has been involved in revisions of OH guidelines, most recently Work Rehab, she has written articles for OPTP, and she is currently spearheading our Petition for Specialization in OHPT.
- John has been an active member of OHSIG for several years. As Nominating Committee Chair, he has secured quality candidates for OHSIG elections. He has contributed to several guideline revisions, most recently Work Rehab. He had a primary role in Defensible Documentation, and more.

We applaud their dedicated commitment to OHSIG. Thank you Dee and John!

PETITION FOR SPECIALIZATION IN OCCUPATIONAL HEALTH PT

The petition has been completed and is in the hands of ABPTS!! Hats off to the whole team! Dee Daley led the efforts along with the entire BOD, and others. This is a huge accomplishment. An update will be provided at CSM.

GUIDELINES UPDATE

Work Rehabilitation Guidelines are complete and in the hands of APTA. We thank Dee, John, the entire OHSIG BOD and others who worked on the Guidelines. We look forward to having these available on the APTA Web site very soon. Updates will be provided at CSM.

Other guidelines are slated for revisions in 2011. Ergonomic Guideline revisions are underway with Rick Wickstrom leading the effort. Gwen Simmons is leading the effort to revise the Legal Guidelines.

OIDAP

We continue to provide feedback to OIDAP (Occupational Information Development Advisory Panel) related to the Summary of Public Comment document. Rick Wickstrom has spearheaded this effort and we thank him for his continued work.

OHSIG feedback provided mid-November was relative to Functional Testing examiners. Our response stated the following: *"Objectivity of disability claims decisions would be greatly improved by inclusion of physical therapists as examiners of functional capacity in the consultative examination (CE) process. Physical therapists with expertise in occupational health have several advantages over medical doctors and other professions because they possess skills related to functional capacity evaluation, job analysis, therapeutic interventions, and job modification that can help bridge the gap between impairments and employment access."*

We will update you at CSM with any new information we have.

OHSIG MEMBER EMAIL BLASTS

Our thanks to Sandy Goldstein, OHSIG Communication Chair, for coordinating the OHSIG member E-mail Blasts. If you have information you'd like to share or have suggestions on topics, contact Sandy at sanfordgoldstein@hotmail.com.

AUTHORS NEEDED

We encourage you to become more involved in OHSIG whether serving on a committee or a task force or writing an article or case study for OPTP. It's a great way to share your expertise with others working in this area of practice.

We thank Jill Galper, PT, MEd, for her contribution to this edition of OPTP. Jill is VP of Occupational Health Services for IMX Medical Management Services. She is also a Fellow, America Board of Disability Analysts. Many of you perform Functional Testing, and I think you will find her information very helpful and relevant.

Please contact any of your OHSIG board if you have questions/comments. We'd love to hear from you!

Professional Regards,
Margot Miller, PT
OHSIG President

PHYSIOLOGICAL SAFETY DURING FUNCTIONAL CAPACITY TESTING

By Jill Galper, PT, MEd, and Rick Wickstrom, PT, CPE, CDMS

The American Physical Therapy Association (APTA) Guidelines for *Evaluating Functional Capacity* defines Functional Capacity Evaluation (FCE) as a detailed examination and evaluation that objectively measures the evaluee's current level of function, primarily within the context of the demands for competitive employment, activities of daily living, or leisure activities. An FCE helps to bridge the gap between impairment and work disability by emphasizing functional, performance-based testing that is not amenable to inclusion in a traditional medical examination by physicians. The length of a typical FCE may range from 3 to 5 hours during a single day test, depending on complexity and related professional time to adequately address indications such as:

1. Assess residual functional status when treatment progress has reached a plateau.
2. Facilitate an appropriate release to return to full or modified duty for claimants who are not working.
3. Investigate discrepancies between subjective complaints and objective findings.
4. Evaluate reports of worker symptoms or difficulties with completion of expected job tasks.
5. Provide supporting documentation for vocational planning.
6. Determine lifestyle impact of physical/functional limitations in medical-legal settlement process.

In published reviews of FCE practices, there are frequent references to a hierarchy of issues that should be considered for protocol design. These issues include: safety, reliability, validity, practicality, and utility. Safety in an FCE has been defined as lack of a new injury. A temporary increase in an evaluee's symptoms is not regarded as unsafe. Safety is listed at the top of the issues to reflect its importance for priority for FCE evaluators.

APTA Guidelines stipulate that physical therapists providing FCEs have the responsibility to ensure that the evaluee is medically stable or that the FCE test protocol is administered within the safe confines of the evaluee's health condition. Medical stability refers to a state where primary healing is complete. There is a consistent presence of specific signs and symptoms at rest or in response to activity. Consistency means that the location of the symptoms and the presence of the signs have reached a plateau. The intensity of the symptoms may vary with activity or treatment, but the location of the symptoms remains consistent.

The purpose of this article is to provide specific guidance to promote an evaluee's physiological safety during an FCE. The scope of this article does not include biomechanical safety issues.

GENERAL CONSIDERATIONS DURING INTAKE/MEDICAL HISTORY

A well-designed FCE process should ensure that evaluees are screened for underlying medical conditions that may prohibit or limit participation in functional testing. The FCE Examiner should perform the following:

- Document the reason(s) for the FCE referral at intake and medical conditions that may impact work abilities at time of referral intake.
- Request information about job tasks and physical demands when a job match is requested.
- Notify the subject to bring a list of all recent medications and to take all medications according to the usual schedule that permits the most optimal level of daily functioning.
- If an evaluee has had recent surgery, it is recommended that the surgeon determine when functional testing is appropriate and provide any relevant medical contraindications or test limitations.
- Perform a comprehensive medical history and identify relevant medical records needed to review medical stability and confirm the appropriate diagnosis. Obtaining a thorough medical history is important to identify the existence of a health condition, even if unrelated to the covered condition or diagnosis, since it might impact the evaluee's safety and performance. The following health conditions are of particular importance for administration of FCE endurance tasks:
  - Cardiac, peripheral vascular, or cerebrovascular disease.
  - Chronic obstructive pulmonary disease, asthma, interstitial lung disease, or cystic fibrosis.
  - Diabetes mellitus, thyroid disorders, renal or liver disease.
- Inquire about the presence of any recent major signs and symptoms of cardiorespiratory disease:
  - Pain, discomfort (or other angina equivalent in chest, neck, jaw, arms or other areas that may be due to ischemia).
  - Shortness of breath at rest or with mild exertion.
  - Dizziness or syncope.
  - Orthopnea or paroxysmal nocturnal dyspnea.
  - Ankle edema.
  - Palpitation or tachycardia.
  - Intermittent claudication.
  - Known heart murmur.
  - Unusual fatigue or shortness of breath with usual activities.
- Address the risks for injury, aggravation of symptoms, or possibility of soreness in response to testing and explain exam procedures that will help reduce such risks, including immediate notification of the examiner of any change in symptoms in response to FCE tasks.

RESTING HEART RATE AND BLOOD PRESSURE CONSIDERATIONS

Usually heart rate is initially taken manually by palpating the pulse over the radial artery manually with the index and middle fingers. This is usually counted for 15 seconds and then multiplied by 4 to determine the per-minute HR. Use of an inexpensive heart rate monitor helps the examiner monitor heart rate changes in response to varying workloads.

It is recommended that two measurements of resting blood pressure in the same arm (minimum of 1 minute apart) after the evaluee has been seated quietly for 5 minutes in a chair with back support and their arm supported at heart level.

Some evaluees may be initially anxious, particularly at the outset of an FCE, when resting blood pressure and heart rate are measured. If evaluee is asymptomatic, but presents with tachycardia (HR > 100 beats/minute) or hypertension (defined as BP > 140/90 mmHg) during seated rest, then the following procedures are recommended:

1. With hypertension, retake blood pressure in the opposite arm (there may be up to a 20 mmHg difference in systolic blood pressure and a 10 mm Hg difference in diastolic blood pressure between arms). A greater variation than this could reflect an underlying health problem. Taking blood pressure in the opposite arm can be done immediately after the prior measurement was obtained.
2. With hypertension or tachycardia, have the evaluee sit quietly for 15-20 minutes and then re-measure heart rate, followed by blood pressure in each arm.
3. If the evaluee remains hypertensive, proceed with the musculoskeletal evaluation and then retake resting HR and seated blood pressure after 5 minutes of seated rest. It is possible that heart rate or blood pressure may lower once the patient becomes more at ease with the test process.
4. If the patient still remains hypertensive but less so after the musculoskeletal evaluation, proceed with a functional test activity that is not strenuous, such as a walking, handling or fingering test, and then retake blood pressure after the evaluee has an opportunity to rest.

If the evaluee continues to demonstrate significantly hypertension (BP reading 160/100 or greater) or tachycardia (HR 100 beats/minute or greater), then the evaluee should be encouraged to contact their physician's office for medical clearance or further instruction.

SOME PRACTICAL TIPS FOR FCE TASK ASSIGNMENT BASED IN RESTING BLOOD PRESSURE AND TASK STRENUOUSNESS

It is usually possible for asymptomatic individuals to perform some FCE tasks even when high blood pressure is present. The following guidelines may be considered for management

of asymptomatic individuals with resting hypertension during the FCE process:

- SEVERE hypertension (≥200/≥110) at rest should not prevent most individuals from doing SEDENTARY work; however, emergency referral is warranted if symptomatic.
- MODERATE (Stage 2) hypertension (160-199/100-109) at rest should not prevent most individuals from doing LIGHT or MEDIUM physical demands, if asymptomatic.
- MILD (Stage 1) hypertension (140-159/90-99) at rest should not prevent most individuals from doing HEAVY or VERY HEAVY physical demands.

REASONS TO TERMINATE TESTING

The evaluee's symptoms, heart rate, blood pressure, and rating of perceived exertion (RPE) should be monitored in response to most endurance tasks. If an evaluee demonstrates or reports shortness of breath, then monitoring of respiratory rate and oxygen saturation with a pulse oximeter is advised.

During the FCE, tasks should be stopped if any of the following occurs:

- Onset of angina or similar angina-like symptoms.
- Signs of poor perfusion: light-headedness, confusion, ataxia, pallor, cyanosis, nausea, or cold and clammy skin.
- Failure of HR to increase as expected with exercise intensity.
- Subject requests to stop.
- Physical/verbal manifestations of severe fatigue, shortness of breath, wheezing, leg cramps.
- Heart rate exceeds 85% of age adjusted maximal heart rate (220-age). Note: Because of individual variation in maximum heart rate, it is possible for the upper limit of 85% of the estimated maximal heart rate during an exercise test may represent a maximal effort for some individuals.
- Certain medications like beta blockers lower the heart rate at rest and in response to activity. This justifies using a psychophysical rating of perceived exertion (such as "Very hard") as an added safety endpoint for these individuals.
- A drop in systolic blood pressure (>10 mm Hg decrease in SBP despite an increase in workload) or failure of SBP to increase with increased workload, is considered an abnormal test response." Anxious patients who demonstrate a drop in systolic blood pressure during the onset of exercise, without corresponding signs and symptoms, generally do not warrant test termination.
- A relative contraindication to terminate exercise testing is a hypertensive response, defined as a systolic blood pressure of > 200 mm Hg and/or a diastolic blood pressure of > 110 mmHg.

As in medical practice, the dictum, "first, do no harm" is of utmost concern for physical therapists. The FCE evaluator can ensure the safety of his or her evaluee by identifying specific physiological, biomechanical and psychophysical endpoints during FCE, performing a relevant clinical examination and closely monitoring the evaluee's performance during testing.

DISCLAIMER: The content of this article is intended to share the author's practical perspectives based on consideration of existing guidelines and experiences from conducting and reviewing many FCEs. These perspectives are not intended substitute for appropriate professional collaboration and clinical decision-making on a case-by-case basis to ensure the physiological safety of persons referred for functional capacity testing.

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THE USE OF COLD LASER IN CONJUNCTION WITH TRACTION AND LUMBAR EXTENSION EXERCISES FOR TREATMENT OF LUMBAR DISC HERNIATION

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PERFORMING ARTS

SPECIAL INTEREST GROUP

PRESIDENT'S LETTER

As I write this in November, the days are growing shorter and colder. We have not yet reached the shortest day of the year or climax of the holiday season. By the time you read this however, that will be behind us, and the PASIG will be in full swing preparing for CSM 2011 in New Orleans, Louisiana.

CSM 2011 is going to be a powerhouse meeting. The PASIG programming is scheduled for **Saturday February 12, 8 – 11 am and entitled "Movement Impairment Issues in Performing Artists: Considerations for Evaluation and Treatment of Upper and Lower Quarter Injuries."** We have terrific presentations and presenters; the details are included in this newsletter. Thanks to Lisa Shoaf, PASIG Vice President and Education Chair, for planning this excellent educational program.

Besides the programming, one of the most important things you can do at CSM is to attend the PASIG Business Meeting. The meeting is open to all, members and nonmembers. Remember that membership in the PASIG is FREE to Orthopaedic Section members. **The PASIG Business Meeting will be held on Saturday, February 12 at 7 a.m.** Breakfast and coffee will be provided!

As of the deadline for submission, Orthopaedic Section elections are still ongoing. The next PASIG President and Nominating Committee Member will be inducted at CSM 2011 in New Orleans during the business meeting. Please come out and support your organization.

Also at this time, we have not yet selected the PASIG student scholarship winner. The award will be given during the business meeting at CSM to a student who performs research that contributes to the Performing Arts body of literature. The award is $400 to help defray the cost of presenting your research at CSM

Many of you have already filled out the Membership Profile Update, so now you and your practice information can be found on the PASIG membership directory. IF YOU HAVE NOT DONE THIS YET, YOU MUST FILL IT OUT TO BE FOUND IN THE PASIG MEMBERSHIP DIRECTORY. With our advanced search capability, performing arts physical therapists can connect with each other and connect our patients when they travel out of the area. The profile can be found at http://www.orthopt.org/sig_pa.php. Click on the link on the right that says "PASIG member profile update;" it takes 5 minutes or less to fill out.

If you haven't perused the PASIG Web site lately, then you might be missing some vital information. There is a wealth of information located there including:

- Archived monthly citation blasts, by date and topic
- Listing of officers
- Member Directory with an advanced search
- Meeting minutes from our annual meetings at CSM
- Member profile update to provide detailed information about your PA experience, relationships, practice information
- A list of clinical affiliations
- A list of Entry-level PT Programs With a Strong Performing Arts Curriculum
- Performing Arts Glossaries (Ballet and Figure skating)
- Information regarding the PASIG Student Scholarship
- Technical report from the PASIG practice analysis
- A bulletin board to ask questions

The PASIG has been working on more resources for you to access on the Web site. **COMING SOON** will be a Resource Page with links to citation blasts and articles related to performing arts. A screen shot of how that will look can be found on the next page. It will be live on our Web site by CSM 2011.

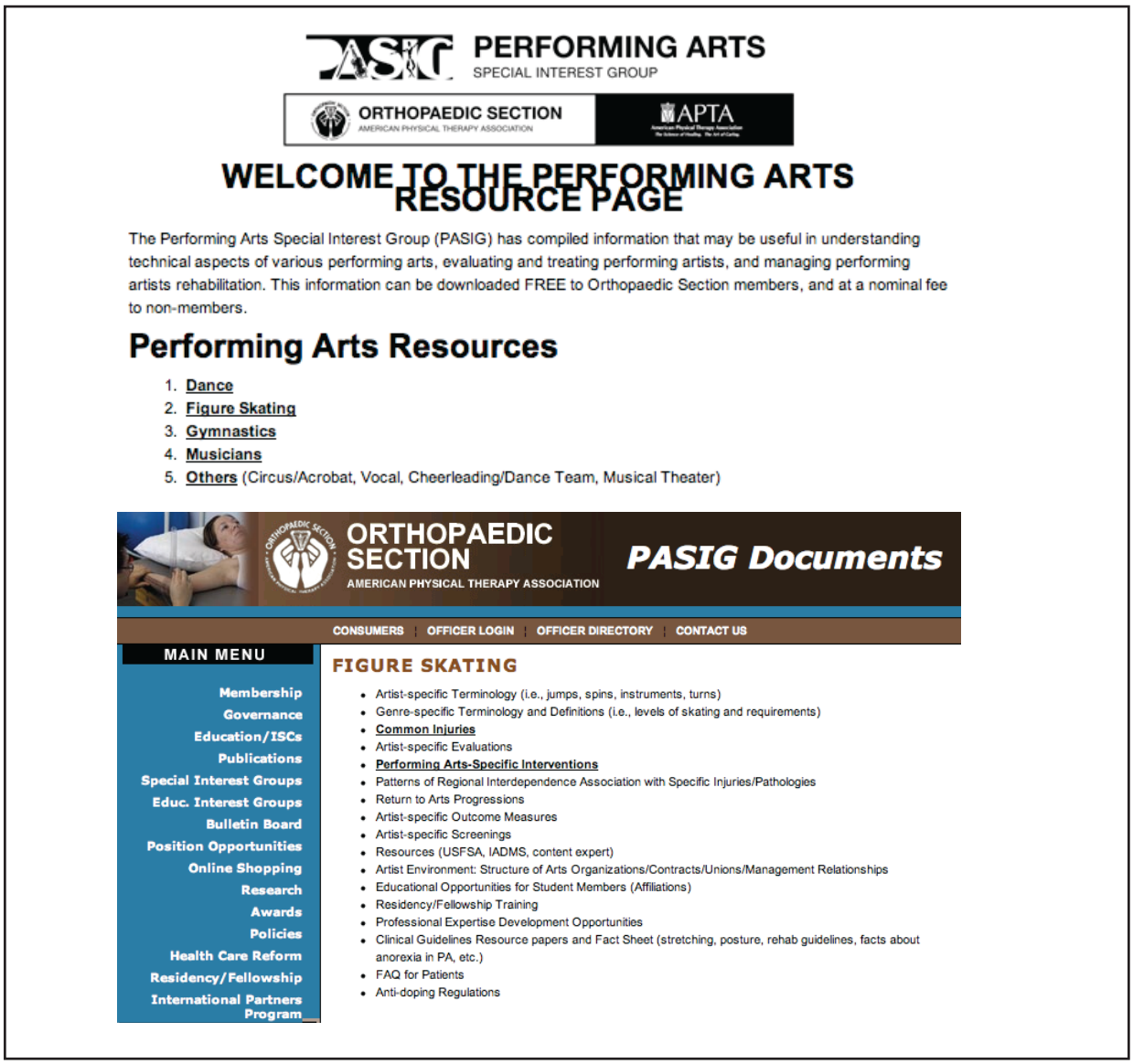
Other projects that are ongoing include adding articles to the NEW Resource Page, updating and adding glossaries to the Web site, and as always, keeping the monthly citation blasts going. Please contact me at Lar@LarPT.com with questions, feedback, and to volunteer.

CSM 2011 comes full circle for me since my first CSM was in New Orleans in 2005 when I was inducted onto the PASIG Board as Treasurer. It was my first time to New Orleans, and I am glad that I saw it before Hurricane Katrina, so that I could better envision and relate to what happened there.

Over the past 6 years that I have been on the PASIG board, I have grown tremendously as a physical therapist and leader. I have learned a great deal about how the Orthopaedic Section works, connected with many of the PASIG members, and made friends with the other board members. All of these things provided me professional opportunities that I otherwise would not have had if I were not involved. I want to give a big **"thank you"** to the board members who have supported, helped and taught me, as well as the staff of the Orthopaedic Section who work tirelessly behind closed doors for the PASIG.

I hope to see you at CSM, it is always nice to put faces with names. See you in New Orleans!

Until then, *yours in the arts,*
Leigh A. Roberts, PT, DPT, OCS



CSM 2011 Programming Saturday, February 12, 2011 8 am – 11 am

MOVEMENT IMPAIRMENT ISSUES IN PERFORMING ARTISTS –CONSIDERATIONS FOR UPPER AND LOWER EXTREMITY EVALUATION AND TREATMENT

This session will provide an overview of movement impairment issues for the performing artist using the principles of the Movement Impairment Syndromes as originally described by Sahrmann. The diagnostic and classification process will be demonstrated with modifications to evaluate and treat performing artists. The upper quarter will be discussed first followed by relevant case studies applying this information to instrumental and vocal musicians. Lower quarter will then be discussed followed by relevant case studies for dance and figure skating.

8:00-8:45	Movement Impairment Issues of the Upper Extremity in Performing Artists Lynette Khoo-Summers, PT, DPT
8:45-9:05	Case Study of a Instrumental Musician with Upper Extremity Dysfunction Jan Dommerholdt, PT, DPT, MPS
9:05-9:25	Case Study of a Vocal Musician with Upper Quarter Dysfunction Alison Deleo, PT, DPT, MS
9:25-10:10	Movement Impairment Issues of the Lower Extremity in Performing Artists Lynette Khoo-Summers, PT, DPT
10:10-10:30	Case Study of a Dancer with Lower Extremity Dysfunction Julie O'Connell, PT, ATC
10:30-10:50	Case Study of a Figure Skater with Lower Extremity Dysfunction Jennifer Flug, PT, DPT
10:50-11:00	Wrap Up Question and Answer

PAIN MANAGEMENT

SPECIAL INTEREST GROUP

PRESIDENT'S MESSAGE

John E. Garzione, PT, DPT, DAAPM

It is hard to believe that CSM is quickly approaching and the Holidays are over. Wishing you all the best in the New Year.

This year's schedule is for the PMSIG's business meeting to be held on Friday, February 11th at 7:00 to 8:00 a.m. which will be followed by our program entitled "Enhancing Clinical Practice Through Psychosocial Perspectives in the Management of Low Back Pain" presented by: J. Reynolds from the APTA Publications Department in Alexandria, VA; C. Main from Keele University in Staffordshire United Kingdom; and S.Z. George from the University of Florida in Gainesville, FL.

This session will explore cutting-edge and future directions in the psychological approaches in health care, with the focus on musculoskeletal disorders, particularly low back pain. The presenters will review the current knowledge and the exciting opportunities in research, practice, and education. This international, multidisciplinary panel consists of authors who contributed to the PTJ special issue on psychological perspectives (February 2011) and will discuss topics ranging from psychological disorders versus normal psychological processes (beliefs, emotions, and behavior), relevant psychological models for development and maintenance of chronic low back pain, importance of context and timing in examination, influences on pain and disability, influences on outcome (predictors, mediators, and moderators), screening and risk identification, modifiable versus unmodifiable risk factors, psychologically informed interventions, evidence for commonly implemented psychological and behavioral interventions, moving from treatment to prevention, "blue flags," occupational obstacles to recovery, and challenges to professional education.

RANDOM THOUGHTS

1.) What did Harvey Korman (Blazing Saddles star), Senator Bob Dole, Dole's father, and Albert Einstein have in common? They all had aortic abdominal aneurysms (AAA, and not the helpful triple A) that killed all but the Senator, who underwent corrective surgery. Why would I mention this in this message? Because it affects 2% to 4% of all adults and is the thirteenth leading killer favoring men seven times more than women. It commonly occurs at 55 years old and peaks between the ages of 65 to 75. There may be no symptoms except for a nagging pain in the back, stomach, neck, or scrotum which, if missed by the physician, may lead a person to physical therapy for pain management. Our evaluation in this age group should include palpation of the abdomen. If a pulsating mass is detected, and the person is not pregnant or harboring an alien, then an aneurysm should be suspected and the patient sent for ultrasound or CT work-up to determine the size of the beast. A normal aorta is 2 cm in diameter while 3 cm and greater is "aneurismal." If the diameter is more than 5.5 cm or it is growing more than .5 cm a year, the patient will be spending special time with his favorite surgeon.[1]

2.) Have you ever noticed that some patients are more compliant with their home exercise programs than others? After many years of pulling my hair out, which is one reason why I have that noticeable bald spot, I looked into the separate learning processes of people. OK, OK I know that most of you educators are aware of this but I am a slow learner in this respect. Some people are visual learners, like my wife who I have to draw pictures for her to get her to remember anything, and others are strictly auditory learners, like me. The visual learners do well with the exercise diagrams while the auditory people glance at the diagrams with a total look of confusion. (I think that is why many men never look at the directions to assemble items because all of those confusing pictures). The auditory learners learn by listening to the spoken word with key reminders written. Visual learners remember best what they see: pictures, diagrams, flow charts, time lines, films, and demonstrations. If something is simply said to them they will probably forget it. Auditory learners remember much of what they hear and more of what they hear and then say. They get a lot out of discussion, prefer verbal explanation to visual demonstration, and learn effectively by explaining things to others.[2] So now, even in the busy clinic environment, I not only give the written diagrams, I give verbal instructions, and demonstrations and then ask the patient to demonstrate the program back to me. It takes a lot longer to do, but this way I am sure that I have covered all bases of the patient's learning style. My next process in self discovery is to determine why I never stop to ask directions.

Hope to see many of you at CSM.

REFERENCES

1. Sackier JM. Avoiding cockpit explosions. *AOPA Pilot*. 2010:34.
2. Felder RM, Silverman LK. Learning and teaching styles in engineering education. *Engr Education*. 1988;78(7):674-681.

CSM HIGHLIGHTS

Friday, February 11, 2011

Pain Management SIG Business Meeting

7:00 - 8:00 am

Followed by:

Enhancing Clinical Practice through Psychosocial Perspectives in the Management of Low Back Pain

Join us in New Orleans.

ANIMAL REHABILITATION

SPECIAL INTEREST GROUP

Hello to all our members! It's hard to believe that another year has almost passed (or may be, by the time this is published!). Hope all of you have a happy holiday season and a happy and successful 2011!

MARK YOUR CALENDARS!

The 2011 Combined Sections meeting is coming up in New Orleans! Our ARSIG Business Meeting is Friday, February 11th, from 7-8 a.m. In addition, we are pleased to have Dr. Janet Van Dyke, DVM, as our speaker this year. Her presentation is entitled, "Veterinary Zoonoses, What You Need to Know Before You Treat That Puppy! and Veterinary Red Flags, Endocrine, Metabolic, and Medical Syndromes That Might Be Lurking in Your Canine Rehab Patient" and promises to be very informative. She will speak on Friday, February 11th, from 8-11 a.m.

ARSIG CONFERENCE CALL MINUTES

There was a conference call on September 30th for board members and committee chairs to discuss several issues. On the education front, there had been discussion about trying to receive "read for credit" through OPTP , but at this time it did not appear to be a feasible option for various reasons, so we are looking into using the Orthopaedic Section's Web site to post information for our members regarding zoonoses, bowel and bladder management for neurological cases, red flags and metabolic disorders, home exercise programs, and information on radiology/diagnostics. We are also looking for contributions from members regarding evaluation forms, functional scales, home exercise programs, and the like to be placed on the Web site so others don't have to "reinvent the wheel." If any of you have documents you would like to share, please send them in pdf format to Lisa Bedenbaugh at LHinerman2@aol.com.

On the legislative side, there continues to be progress made in changing the language in the physical therapy and veterinary practice acts in Nebraska, allowing other health care practitioners to be able to register with the veterinary board to collaborate with veterinarians in treating animals in their specific area of specialty. In California, there was a bill submitted that would interfere with the ability for PTs to practice on animals, but it was temporarily halted, pending further input to legislators from interested parties.

We are also trying to revamp our ARSIG state liaisons, and our goal is to have a representative from each state. If you are interested, please E-mail our liaison coordinator, Charlie Evans at cevans@ivghospitals.com with your contact information.

From a research perspective, we discussed trying to start work on databases, such as range of motion in "normal" dogs vs. those with OA, in order to start tracking trends. If anyone has any interest in this area, please contact our Research Chair, Cheryl Riegger-Krugh at crieggerkrugh@gmail.com for more information. We appreciate all of you who give time and effort to promote our profession!

Lumbosacral Disease: Differential Diagnosis

Tammy Wolfe, PT, CCRP

A common patient problem I encounter in my canine patient load is hind limb weakness resulting in frequent falls and difficulty walking. Spinal cord compression, frequently called lumbosacral disease, LS syndrome, cauda equina, or type II disc disease, is a common occurrence in the aging canine population. Typical history and symptoms are as follows:

- Geriatric populations (over 7 years old in large and mid-size breeds and 10 years old in small breeds)
- Insidious atrophy and weakness in the hind limbs
- Ataxic gait and a wide base of support
- No differences in gender occurrence or in intact vs spayed/neutered
- Frequent falls and difficulty getting up into standing from lying and sitting, especially on slick surfaces
- Difficulty or inability to go up stairs or jump onto furniture or into the car/SUV/truck
- Increased flexion of the spine in standing and during ambulation
- Advanced disease will include knuckling (decreased proprioception)
- Deep tendon reflexes may be normal, decreased, absent or hyper reflexive, depending upon the severity and level of the spinal compression

There seem to be no differences in gender occurrence or in intact vs spayed/neutered. In more advanced stages, symptoms may be accompanied by pain responses, muscle spasms in the epaxial muscles (canine paraspinals) and abdominals, and incontinence of bowel and/or bladder.

Because disc bulges and ruptures occur more centrally in canines, the patient frequently loses hind limb function before showing any signs of pain. Physical therapy is the treatment of choice for these dogs and is very effective in slowing or halting the progression of symptoms and may reverse many of the effects of spinal compression. Treatment will include instructions to the owner to apply manual traction and to progress with home strengthening exercises for the core and extremities. Physical therapy will include decompression techniques, neuromuscular re-education, balance and strengthening exercises, and usually a form of hydrotherapy exercise. If the canine is showing signs of pain and muscle spasms, the owner will be instructed in applications of heat or cold and massage techniques. Medically, the dog may be treated with NSAIDS, and, in more acutely severe episodes, a short round of Prednisone, along with pain medications and possibly muscle relaxants.

A classic patient vignette would read like this: Rocky is an 11 year old male, intact Akita presenting with an ataxic gait at a walk, a wide base of support in the hind limbs, and decreased

stride length. His thoracolumbar spine is mildly flexed. His owners report that Rocky has progressively become weaker in his hind limbs in the past year and now has extreme difficulty going up stairs, getting up from lying on the kitchen floor, and getting into the car. He isn't able to walk as far as he could a few months ago. In the past month, he has had some bowel incontinence. After completely evaluating Rocky, if no red or caution flags are discovered, either in history taking or the examination, I would continue treating Rocky as having the above diagnosis.

A similar vignette I have seen is as follows: Lucy is an 11 year old female, spayed Miniature Schnauzer brought in by the owner's friends because the owner couldn't get off work. History was described as Lucy having difficulty over the last few weeks in jumping up on the couch and bed, and was no longer able to do so. Her owner reported hind limb weakness and frequent falls on smooth floors and bladder incontinence, which was getting worse. She seemed to be sore in her back and didn't want to go on walks any more. Their primary veterinarian saw her 3 weeks prior and started her on Rimadyl (canine NSAID) and some medication for the incontinence. She had continued to get weaker and the incontinence had gotten worse.

Before looking at the dog, a caution flag for me was that a dog this small usually has type I disc disease, in which they suddenly lose hind limb function completely. This is a medical emergency and the patient must have surgery within 24 to 48 hours in order to have a favorable recovery. However, I have seen older, smaller dogs with similar histories from the owners who have spondylosis and become weak from not using the hind limbs secondary to pain in the spine.

Examination threw more red and yellow flags up. Gait was only mildly ataxic in the hind limbs and with a wide base of support in all extremities. Instead of a flexed spine (topline), I observed a sway back posture. Atrophy in the hind limbs was mild, but also slightly present in the front limbs and core musculature. Proprioception was intact. Reflexes were normal. The dog did not respond with any pain responses on evaluation of the spine and hind limbs. Joint and soft tissue evaluations were negative for any findings. This dog did not fit the typical case pattern and appeared to me to be having a more systemic issue going on. She had moderate gum disease, but normal capillary re-fill time. I referred this dog urgently to a veterinarian for blood tests and urinalysis. The tests came back with glucose levels in the 400's. The patient was treated for diabetes mellitus and started on an insulin regimen. Within 3 days she was acting "normal" again as reported by her owner and the "incontinence," which had been brought on by excessive drinking, had disappeared completely.

A third vignette I have seen is as follows: Argo, a 4 year old, intact, male, bomb sniffing German Shepherd police dog, who had previously been treated successfully for lumbar spondylosis and sciatica was brought in with reports of a relapse. His handler said that he had been fine until a couple of nights ago when he fell while running. Since then, he had been unable to get up on his hind limbs and jump into the SUV. His handler was going out of state to a continuing education course for a week and was boarding Argo so he could have physical therapy. Upon initial evaluation, Argo's symptoms were as before when I had seen him. He presented with a mild right hind limb limp, slightly shortened stride length, decreased right L7 nerve mobility with pain response, a mildly flexed thoracolumbar spine, epaxial and oblique spasms, bilateral hind limb weakness, and otherwise, a normal neurological and orthopedic examination. He was treated appropriately on Friday and appeared to be in less pain following treatment. His gait was still with mildly decreased weight bearing on the right, but the topline had returned to normal and strides had lengthened in the hind limbs. However, upon re- evaluation on Monday, Argo presented with different findings. The boarding staff had reported that he was frequently falling down and had urinated on himself once. They were using a towel in front of his hind limbs to assist him with his balance. Examination revealed a moderately ataxic gait in the hind limbs, but with very mild ataxia in the front limbs and core. Proprioception and DTRs were normal, however. Hind limb weakness and control had deteriorated significantly. Argo had begun to have difficulty with total body control and appeared lethargic and even somewhat confused. Concerned about a possible brain or brain stem issue, I immediately conferred with the in-house neurologist. Her findings were the same as mine and she asked for clearance from the police department for a CT or MRI. Because of Argo being government property, it took a few days to get the tests approved. In the meantime, the neurologist was able to get blood work approved. Argo continued to become more lethargic and at times, unresponsive to verbal communication. His proprioception declined, but his DTRs were still normal. The blood work came back normal except for an extremely high chloride level. The attending neurologist took Argo off all medications. He started to improve neurologically within the first 24 hours. When testing his medications, it was discovered that someone in the pharmacy had added the wrong ingredient to his batch of Tylin powder. (GI antibiotic commonly used in canines for controlling diarrhea.) Instead of adding the filler, they had added Potassium Bromide. Argo was inadvertently being poisoned. Unfortunately, until the cause was found and all buyers of that batch of Tylin powder were notified, 2 other canines had been euthanized because of the same symptoms.

I have been fortunate enough to have spent over 7 years working with canines in a physical therapy practice in a world-famous, specialty veterinary hospital. Many of the evaluation findings and caution and red flags are the same as in humans. However, because of the communication gap, and because many times dogs are left by themselves while the owners go to work, the history of symptoms can be incomplete. The owners may or may not see the whole picture, or may be misinterpreting what they do see. Also, because all owners seeking physical therapy for their animals are privately paying, more expensive testing is, many times, not an option during the diagnostic process. Working with animals has sharpened my evaluation and observation skills dramatically and has made me more aware of the need to refer a patient to another professional when the examination, history, and symptoms throw up a caution or red flag.

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- Cervical and Thoracic Pain: Evidence for Effectiveness of Physical Therapy (6 monographs)

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The Orthopaedic Section will be seeking CEU approval from the following states for the 2011 courses listed above: CA, NV, OH, OK, TX.

Current Courses Available

3-Monograph Courses

- Physical Therapy for the Performing Artist
- Basic Science for Animal Physical Therapists: Equine, 2nd Edition
- Basic Science for Animal Physical Therapists: Canine, 2nd Edition
- Reimbursement Strategies for Physical Therapists (Only Available on CD.)
- Diagnostic Imaging in Physical Therapy (Only Available on CD.)

6-Monograph Courses

- Orthopaedic Implications for Patients With Diabetes
- Joint Arthroplasty: Advances in Surgical Management and Rehabilitation
- Update on Anterior Cruciate Ligament Injuries
- The Female Athlete Triad
- Orthopaedic Issues and Treatment Strategies for the Pediatric Patient
- Low-Back Pain and the Evidence for Effectiveness of Physical Therapy Interventions (Only Available on CD.)
- Movement Disorders and Neuromuscular Interventions for the Trunk and Extremities
- Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers
- Vestibular Rehabilitation, Dizziness, Balance, and Associated Issues in Physical Therapy (Limited print copies available.)

REGISTER ONLINE www.orthopt.org

Additional Questions?
Call toll free: (800) 444-3982 or visit our Web site at: www.orthopt.org.

How it Works

Each independent study course consists of 3, 6, or 12 monographs in a binder along with instructions for completing the final examinations online. If you are unable to complete the final exam online you can request hard-copy materials from the Section office. Monographs are 16 to 28 pages in length and require 4 to 6 hours to complete. Ten multiple-choice review questions are included in each monograph for your self assessment (answers are on the last page). *Current Concepts of Orthopaedic Physical Therapy* consists of case scenarios and multiple-choice questions. The final examination consists of multiple-choice test questions. Exams for 3- and 6-monograph courses must be completed within 3 months. Exams for *Current Concepts of Orthopaedic Physical Therapy* must be completed in 4 months.

Educational Credit

To receive continuing education, registrants must complete the examination and must score 70% or higher on the examination. Registrants who successfully complete the examination will receive a certificate recognizing the contact hours earned.

Number of monographs per course	Contact hours earned
3-monograph course	15
6-monograph course	30
12-monograph course	84

Only the registrant named will obtain contact hours. No exceptions will be made. Registrants are responsible for applying to their State Licensure Board for CEUs.

Please visit our Web site for additional courses approved by CA, NV, OH, TX, OK, and NATA.

Registration Fees

	Orthopaedic Section Members	APTA Members	Non-APTA Members
3-monograph courses	$100	$175	$225
6-monograph courses	$190	$290	$365
12-monograph course	$290	$540	$540

If notification of cancellation is received in writing prior to the course, the registration fee will be refunded less a 20% administrative fee. No refunds will be given after receipt of course materials.

When you provide a check as payment, you authorize us either to use information from your check to make a one-time electronic fund transfer from your account or to process the payment as a check transaction. For inquiries please call 800-444-3982. When we use information from your check to make an electronic fund transfer, funds may be withdrawn from your account as soon as the same day you make your payment, and you will not receive your check back from your financial institution.

I am registering for course(s) _____

Name _____

Credentials (circle one) PT, PTA, other _____

Mailing Address _____ City _____ State _____ Zip _____

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Daytime Phone _____ APTA# _____ E-mail Address _____

Please check: ☐ Orthopaedic Section Member ☐ APTA Member ☐ Non-APTA Member

I wish to join the Orthopaedic Section and take advantage of the membership rate. (Note: Must already be a member of APTA.) ☐ I wish to become a PTA Member ($30). ☐ I wish to become a PT Member ($50).

Fax registration and Visa, MasterCard, American Express, or Discover number to: (608) 788-3965

Visa/MC/AmEx/Discover (circle one)# _____

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Mail check and registration form to: Orthopaedic Section, APTA, Inc., 2920 East Avenue South, Suite 200, La Crosse, WI 54601. 800-444-3982

Call for ISC Authors

The Orthopaedic Section, APTA, Inc. published its first Independent Study Course in 1991. Since that time we have served over 16,000 registrants. Our goal is to produce high quality, clinically applicable courses that serve as a credible up-to-date resource for today's clinician.

The Section currently publishes 2 to 4 courses each year. Courses consist of a varying number of monographs, each written by a different author and addressing a particular aspect of a single theme. Authors work closely with our Independent Study Course Editor to define the scope of content and learning objectives of their individual monographs. This collaboration ensures that the monographs complement each other and provide a coherent continuing education experience for our registrants. Some monographs also are reviewed by invited subject matter experts to "peer review" the accuracy of each monograph. Every year, the Orthopaedic Section is proud to include among its Independent Study Course authors recognized leaders in the field of physical therapy and related health professions. We also offer publication opportunities to talented first-time authors, as well. This includes PT faculty, post-graduate students, and practicing physical therapists and others who can share their expertise through the ISC series.

As an Independent Study Course Author, you receive:

- Valuable experience with the professional publication process
- A generous honorarium
- An allowance of up to $500 for reimbursable expenses
- Technical and knowledgeable editorial support
- A complimentary copy of the entire course
- A compilation of registrant evaluations of your monograph at the conclusion of the course

We are currently looking for authors for our 2013 courses.

To learn more about our program, call the Orthopaedic Section office at 800-444-3982 x 213 or e-mail Kathy Olson. To apply as an ISC author, please complete and submit the form found online at www.orthopt.org.

Orthopaedic Section CSM Schedule can be found at www.orthopt.org

Orthopaedic Physical Therapy Practice

Instructions to Authors

Christopher J. Hughes, PT, PhD, OCS, Editor
Sharon L. Klinski, Managing Editor

1. *Orthopaedic Physical Therapy Practice (OPTP)* serves as a publication option for articles pertaining to clinical practice as well as governance of the orthopaedic section and corresponding Special Interest Groups (SIG). Articles describing treatment techniques as well as case studies, small sample studies and reviews of literature are acceptable. Papers on new and innovative technologies will also be considered for publication. Language and format of articles should be consistent with the *Guide to Physical Therapist Practice*. SIG authors must adhere to the 12 page limit when submitting articles as part of SIG report.

2. Manuscripts should be reports of personal experiences and written as such. Though suggested reading lists are welcomed, references should otherwise be kept to a minimum with the exception of reviews of literature. All authors are required to sign a consent form indicating verification of original work and this form must accompany your work at the time of submission. This form can be found on the Orthopaedic section website (www.orthopt.org) under the Orthopaedic Physical Therapy Practice link. Authors are solely responsible for proper citation of work and avoiding any issues with copyright infringement related to writing or use of images or figures. For more information on plagiarism authors may find the following resources helpful:
http://www.plagiarism.org/
http://www.turnitin.com/research_site/e_home.html

3. Presenting research: OPTP welcomes traditional experimental research studies as well as case reports. Studies involving human subjects must have successfully met the requirements and been approved through an institutional review board. Case reports of involving 3 or less subjects must follow HIPAA guidelines in protecting the privacy of subjects. For more information access the following:
http://www.hhs.gov/ocr/hipaa/

4. **Article Review Process**
Authors will be immediately notified of receipt of document by managing editor. All initial reviews are done by the editor, managing editor, and also possibly a member of the advisory council of OP. A schematic of the review process is attached. Articles are reviewed in the order in which they are received. You will receive a confirmation of your submission and will be updated on the status of your work as we complete the review process. A schematic of the review process is attached.

5. **Manuscript Preparation Guidelines**
Title Page - include the author's name, degree, title, current place of work or affiliation, corresponding address, phone and FAX numbers, and email address.

Abstract - Abstract of 150 words or less using double space format. Abstracts at minimum should include the following headings: Background and Purpose, Methods, Findings, Clinical Relevance
Key words should also be listed after the abstract.

Format - text should be a minimum of 12 pages double-spaced, use a 12-point font; margins should be 1 inch on each side. Headings should be formatted as follows:
MAIN HEADING
Secondary Heading
Tertiary heading

Citation of Reference List - references should be numbered sequentially as they appear in the text and should correspond to the superscript number in the text. Do not repeat the same reference using a different number in the reference list. Only references cited in the paper should be listed.

Journal Articles

16. Ferguson CT, Cherniack RM. Current concepts: management of COPD. *N Engl J Med*. 1993;328:1017-1022.
17. Rueben DB, Siu AL. An objective measure of physical function of elderly outpatients (The Physical Performance Test). *J Am Geriatri Soc*. 990;38:1105-1112.

Books

18. Steindler A. *Kinesiology of the Human Body Under Normal and Pathological Conditions*. Springfield, Ill: Charles C. Thomas; 1995:63-64.

Abbreviate United States state and territory names as specified in the *American Medical Association Manual of Style*—NOT according to the United States Postal Service abbreviations.

Editor(s) as author:

19. Scully RM, Barnes ML, eds. *Physical Therapy*. Philadelphia, Pa: JB Lippincott Co; 1989:83-98.

Reference to part of a book:

20. Goodman CC. The endocrine and metabolic systems. IN: Goodman CC, Boissonault WG, eds. *Pathology: Implications for the Physical Therapist*. Philadelphia, Pa: WB Saunders; 1997.

Tables - provide tables to present information more clearly and concisely than if presented in the text. Table titles are usually written as phrases. They are capitalized in title case and do not employ terminal punctuation:

Table 1. Symptoms of Chronic Fatigue Syndrome

Reference to a Web site:
Information on Total Knee Replacements. American Academy of Orthopedic Surgeons. www.aaos.org/wordhtml/research/oainfo/OAinfo_knee_state. Accessed on September 5, 2005.

Format and Presentation of Figures, Graphics, and Tables

Figures and Graphics:

- Figures should be submitted as separate, high-resolution graphic files in TIF, JPG, EPS, or PDF format, with the resolution set at a minimum of 300 dpi. Rule of thumb: the larger the figure (eg, 8 1/2" x 11"), the better. Figures – prepare as 5 x 7 black and white photographs, camera-ready artwork (eg, line drawings and graphs), or as professional-quality computer file images. A photo release form must accompany any photographs where patients may be seen. Figure legends may be phrases or complete sentences, capitalized in sentence case, and end with a period:

  Figure 2. Kinesthetic testing using an electronic inclinometer.

If electronic formats are not available to you, figures must be submitted as 5" x 7" camera-ready glossies and mailed to the Editorial Office. Figures should be numbered consecutively. For helpful guidelines on submitting figures online, visit Cadmus Journal Services (http://www.cadmus.com/). Lettering should be large, sharp, and clear, and abbreviations used within figures should agree with Journal style. Color photographs are encouraged but must be of excellent resolution and good contrast.

- Legends to Figures. Type all legends on one page after the reference list and tables.

- Tables should be formatted in Word and placed together at the end of the manuscript, after the references. Tables should be numbered consecutively. Refer to recent issues for acceptable table formats.

3. Manuscripts are only accepted electronically. **Save your monograph in Microsoft Word or plain text format.** If figures cannot be sent electronically then prepare the content of any original photographs and artwork for shipment. Include a cover letter indicating author and title of the paper the photographs or artwork are to be used for. Send to:

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