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Editor's Note | Treating Osteoarthritis: Are We Up for the Challenge?

Christopher Hughes, PT, PhD, OCS

At the time of this writing, I had the following patient encounters in one week. (1) A somewhat depressed 40-year-old patient who is trying to come to terms with the diagnosis of a moderate grade of knee osteoarthritis (OA) and how it will fit in with his active lifestyle. (2) A previously discharged patient who returned to therapy because he just could not deal with the pain anymore in both knees and his lumbar spine while on his feet at work all day. (3) A warehouse worker in his 30s who asked about what supplements he can take to ward off arthritis. And, (4) A patient who had articular cartilage repair of his knee 6 months ago and who is still challenged by the rigors of being on his feet all day. Sound familiar? I am sure many of you have had similar experiences.

According to the Arthritis Foundation, osteoarthritis affects 27 million Americans.[1] This prevalence has had an enormous economic impact on our current health care and social care systems. Physical therapists treat patients with arthritis all the time, but patients with OA—young, old, and of all levels of activity—are now in the pipeline and the number is rapidly growing. As a profession, we need to be on top of our game to fight the effects of this progressive and incurable disease. With an aging population, more people will be balancing the health care tightrope between types of care versus cost-effective coverage.

So what advances have we made in treating this progressive disease? I can remember in the past, the only advice most patients received from their referring physician besides heading to physical therapy was to get involved in an aquatics program!

Numerous guidelines have been authored by various working groups and associations, including our own Orthopaedic Section,[2] but unfortunately the transfer of these guidelines to direct patient care has been subpar.[3] Today, more than ever before, there is an abundant amount of basic science and clinical research on OA. It is now commonly believed that OA affects the whole joint, including cartilage, subchondral bone, synovium, tendons, and muscles, and it is not just a "wear and tear" phenomenon.[4,5] Healthy articular cartilage is able to handle impressive amounts of load when healthy. However, the irony is that this tissue is totally inadequate (ie, replacement of damaged cartilage by fibrocartilage-like scar tissue) when trying to heal after even the most minor injury.[5] One major reason for this is that articular cartilage is primarily an avascular structure, which tends to suppress the normal mechanisms involved in healing.

As a result of this inability to self-heal, a number of promising new surgical treatments, including stem cell therapy, are being used to augment the body's fight to prevent destruction and repair the joint complex.[6] The efficacy of growth factors, such as platelet-rich plasma (PRP), are also being researched.[7] Time will tell if the outcomes of such procedures will advance the treatment and management of OA. In the meantime our exercise progressions will need to adapt to these new forms of treatment.

On another front, since OA inflicts much pain and disability, patients desperately search for relief and have questions about other remedies such as dietary supplements (ie, glucosamine and chondroitin). Currently the literature shows mixed results on these types of supplements.[8-10] As health care providers, it is our job to make sure we are aware of the literature in this area so patients can be properly educated about what these supplements can and cannot do. Our interactions with our patients demand that we keep abreast of all new medical advances and how they will affect not only our role in treatment, but also the outcome patients expect. Furthermore, it is imperative that we understand the prognosis of OA following injuries to common structures like the ACL, the probabilities of OA from having or not having reconstruction, and the consequences with return to activity.[11]

As directors of physical rehabilitation, it is vital that we thoroughly accept the role we play in prescribing exercise that helps and does not exacerbate the very condition we are trying to treat. Knowing how to dose time and type of exercise is critical for this patient population to preserve joint integrity while maximizing function. Even though our own guidelines show moderate support for what we do with OA of the hip,[2] the mechanisms of how exercise helps OA are still not fully understood.[12]

Exercise is still our best treatment for improving muscle strength in people with hip or knee OA based on a recent systematic review and meta-analysis by Zacharias et al.[13] Furthermore, we need to appreciate the differences we can make in function, as well as the psychological benefits for patients.

Despite our current success, we can do better. What is needed is a concerted effort on understanding all the pieces of care for patients with OA (eg, pharmacological, surgical, psychological) so we can also better understand our role. There is also plenty of room for advancing our knowledge on how to optimize our interventions. We cannot just be satisfied with outdated protocols and basic exercises. We must strive to develop programs that provide the most effective ways to keep patients with OA moving because right now, many do not meet current physical activity guidelines, and this carries over to functional gains.[14,15]

I often tell my patients who have OA that the disease can be viewed as a privilege and not a curse. I tend to not look at it as an "end of the road" problem, but one that represents that they have lived long enough to experience it. I feel it is our job as therapists to not let them succumb to it.

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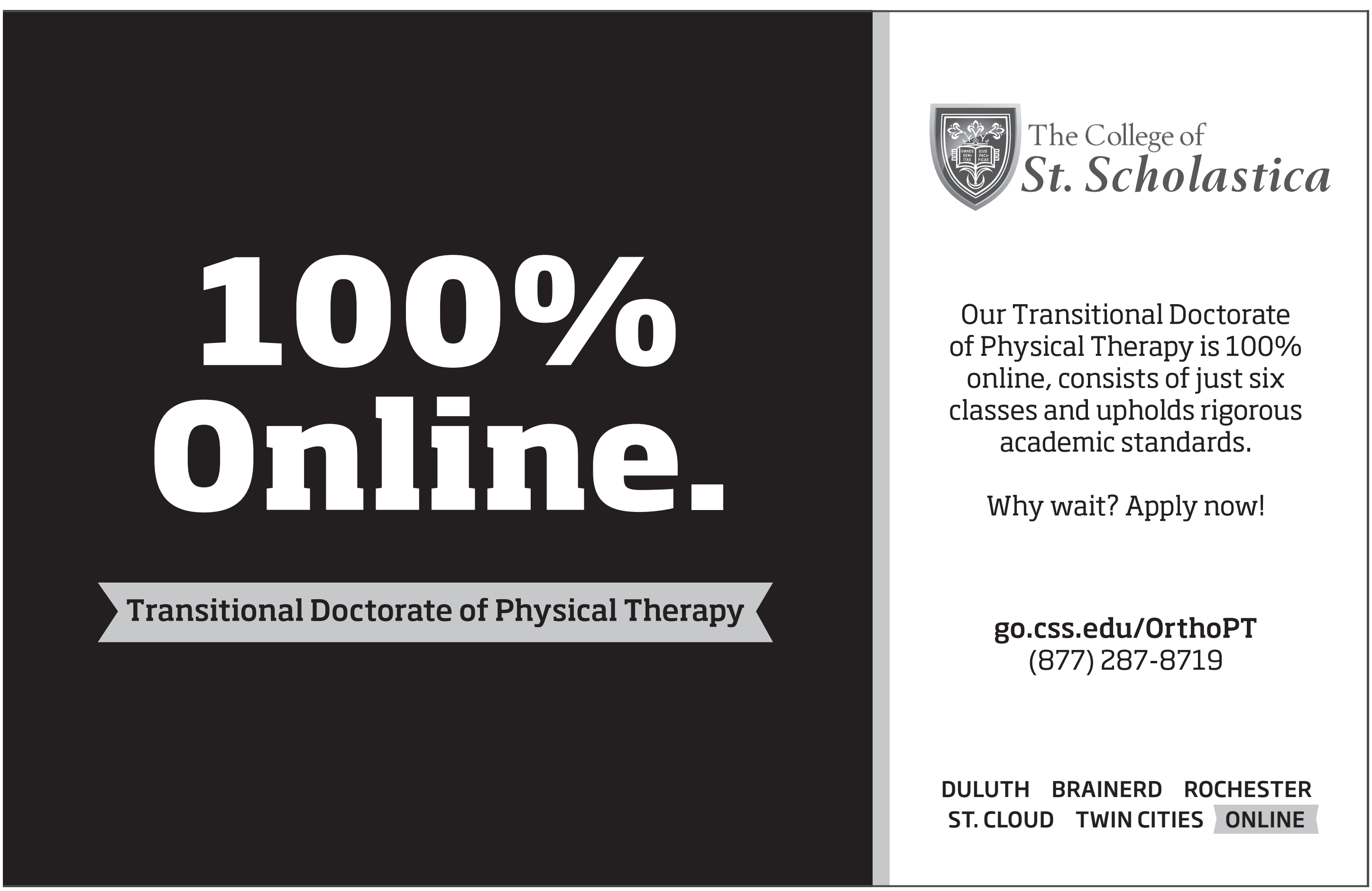

An Integrative Approach to Treating Movement Disorders: The Art and Science of Movement Therapy

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ABSTRACT

Background and Purpose: The purpose of this article is to present a case for combining the art of movement with the science of movement. **Methods and Clinical Relevance:** The teachings of Mable Elsworth Todd and two areas of research that support the use of neuromuscular retraining in the treatment of injury and movement dysfunction are presented. Kinesiological examples are described to justify the treatment of movement disorders, presented in the case example. **Clinical Relevance:** Research supports an integrated approach to treating movement dysfunction and injury. Of prime importance are proximal stability, strength, and control. These elements, important to the dancer, can be applied to many patient populations.

Key Words: neuromuscular rehabilitation, proximal stability, integrated movement, muscle stabilization

INTRODUCTION

There has been recent focus on the importance of proximal stabilization and control in the treatment and prevention of injury. Two areas of research stand out. One area examines the role of the deep or local muscular system that stabilizes the lumbar spine and pelvis and its role in the development of low back pain. The other area looks at the role of proximal hip stability in the etiology of lower extremity disorders such as patellofemoral pain syndrome (PFPS). Both disciplines are moving toward recognition that proximal control must be taught through the training of proper movement patterning. They are basically advocating neuromuscular education and rehabilitation.

Emphasis on proximal stability and the training of proper movement patterning is not new. They were pioneered by kinesiologist, Mable Elsworth Todd, and her student Lulu Sweigard. In 1937 Todd wrote the classic text, *The Thinking Body*, appropriately subtitled *A Study of the Balancing Forces of Dynamic Man*. In the book's preface, Sweigard stated that Ms Todd's unorthodox approach to teaching body balance and motion is "highly effective in producing more efficient mechanics of movement and more pleasing upright figures."[1] She felt strongly that her work should be available to all in the educational system, and not be confined to private teaching." Sweigard expanded Todd's work in the publishing of *Human Movement Potential* in 1974.[2] Unfortunately, the writings of Todd and Sweigard have been overlooked, though they likely influenced the development of "alternative" movement therapies such as Tension Release Alignment,[3,4] their main influence has been on dancers, who realize the importance of tying function to aesthetics and thus combining art with science. Dancers understand that an efficiently moving body is pleasing to watch. Ms Todd discussed "postural patterns," the shape of which is dynamic, always moving, and never static. She proposed that we must attain conscious control of the structural balance of the human body by understanding "its component parts, their relationships, and the forces acting upon and within them."[1] She emphasized that this awareness comes from within the body through proprioception, or perceiving of self. Todd further points out that we are unconscious of most of the small movements involved in posture and locomotion but that it is possible to bring these habitual or automatic movements into consciousness and thus control adjustments. By doing so, we develop a "kinesthetic consciousness." Well-trained dancers work to develop this type of skill and awareness as they strive to move with efficiency, grace, and power. They learn to move from the center, powered by strong hip and thigh musculature, while maintaining a balanced, lengthened trunk. The literature supports this type of training, which can be applied to many movement disciplines.

THE DEEP MUSCULAR STABILIZATION SYSTEM

Dancers are taught to "center" or to pull the abdominal muscles inward and to lengthen upward. The closest correlate to this action found in the literature is "hollowing" or "drawing-in" of the anterolateral abdominal wall, which has been advocated by many authors to improve lumbar stabilization.[5-9] This action stabilizes the pelvis and integrates movement. When dancers move their center, they can balance and move with ease. Centering involves activation of the deepest abdominal muscle, the transversus abdominis (TA). When the body is aligned properly, the TA muscle works synergistically with the other deep stabilizers: the deep lumbar multifidus (DM), the pelvic floor, and the diaphragm to stabilize the pelvis and low back.

Bergmark[11] and Panjabi[12-14] categorized trunk muscles into local and global systems. The local system consists of deep muscles that attach directly into the lumbar spine, such as the DM and those that attach indirectly via the thoracolumbar fascia, such as the TA. Panjabi postulated that the main role of these deep muscles is to stabilize the lumbar spine, since they are short muscles close to the center of rotation of the lumbar vertebrae.[12] Bergmark pointed out that the role of the global, more superficial muscles such as the internal oblique (IO), external oblique (EO), rectus abdominis (RA), and portions of the erector spinae is "to balance the external loads applied to the trunk so that the residual forces transferred to the lumbar spine can be handled by the local muscles."[11]

Numerous studies have supported the assumptions of Bergmark and Panjabi.[15-18] Researchers have demonstrated the stabilization function of the deep muscular system, specifically the TA, diaphragm, pelvic floor, and the DM. Studies using high-resolution electromyography (EMG) techniques to differentiate the function of the abdominal muscles during respiration found the TA to be the most active abdominal muscle during quiet breathing,[15] as well as when breathing was challenged.[16-18] The researchers concluded that breathing is an active process and that the horizontal fibers of the TA are effective at compressing the abdominal contents, tensioning the thoracolumbar fascia, increasing intra-abdominal pressure (IAP), deflating the lungs, elongating the diaphragm, and displacing it into the ribcage.[15-18]

Hodges et al[19] performed in vivo porcine studies to examine the effect of the TA and the diaphragm contraction on lumbar spine stiffness. They found that when the TA or the diaphragm was stimulated electrically to increase IAP, lumbar stiffness was increased. They concluded that increased IAP and contraction of the TA and diaphragm aid in control of spinal stability.

Various studies differentiated the activity of the abdominal muscles during function. Researchers have recorded the activity of the 4 layers of abdominal muscles with fine-wire EMG under guidance of real-time high-resolution ultrasound during arm or leg movements. A summary of the main findings is as follows: (1) Contraction of the superficial abdominal muscles is delayed in response to upper limb movement and occurs after the action of the TA.[20-22] (2) The TA activity is not influenced by preparation time,[22] speed,[21] or direction of movement.[23,23] (3) The TA is the first muscle active during movement of the lower limb.[23] The researchers concluded that the TA is active in a feed forward manner to stabilize the spine and prepare the body for movement disturbance during shoulder, elbow, and leg movements. Abdominal muscle activity was also examined during trunk movement. The TA was found to be the most active abdominal muscle in increasing IAP, creating an extension moment, and stabilizing the spine during the following activities: dynamic and static trunk flexion and extension,[25-27] lifting and lowering,[28] and preparing the body for perturbations.[29,30]

The DM is an important muscle in stabilization of the lumbar spine.[31-33] An in vitro study conducted by Wilke et al[33] simulated the forces of 5 muscle pairs acting together and separately on the lumbar spine. They found that the DM was responsible for more than two-thirds of the increase in stiffness created by muscle action. There is good evidence that exercise targeting the DM reduces the recurrence of LBP after an acute episode[34] in the treatment of spondylolysis and spondylolisthesis,[7] and in managing patients with chronic LBP.[35] Several researchers have demonstrated that the DM co-contracts with the TA to stabilize the low back and pelvis during function.[5,36-38]

It has also been shown that the pelvic floor is activated in synergy with the TA, DM, and diaphragm when the abdominal wall is pulled inward.[38] Hemborg et al[39] found that the pelvic floor contracts during lifting tasks. They concluded that the increase in IAP that occurs during lifting "depends on good coordination between the muscles surrounding the abdominal cavity, ie, the diaphragm, oblique muscles, and the pelvic floor." They did not evaluate the TA. Sapsford et al[40] investigated co-activation of the abdominal and pelvic floor muscles during abdominal hollowing and abdominal bracing in 3 lumbar spine positions. They found that pelvic floor contraction is a normal response to abdominal muscle activation and that activation of the abdominal muscles is accompanied by tightening of the pelvic floor. Two findings are of interest: TA amplitude was increased by a greater amount than that of the other abdominal muscles in all spinal positions and it was greater when the lumbar spine was in neutral or extension. These findings support the premise that the body must be properly aligned for the deep muscular stabilization system to work effectively.

PROXIMAL HIP STABILIZATION

In *The Thinking Body*, Mabel Elsworth Todd[1] very eloquently described the dynamic role of the pelvis in support and movement. Organized movement "takes place at the base of the upright column. The pelvic muscles are the first to consider, being the largest and the strongest and having to control the movement for any change of position of the body mass in space."[1] Todd pointed out that 36 muscles attach to the pelvis, which unites the main units of weight of the skeleton from the head to the lower extremities.[1] Todd further described the pelvis as "a shock absorber against forces coming from two directions: the downward fall of weight from the trunk and the upward thrust from the ground as it receives the impact of the weight."[1] She emphasized the importance of the muscles around the hip joint that provide strength and balance in standing and walking.

A number of studies have investigated the role of hip strength and proximal control in the development of lower extremity (LE) pain and dysfunction. Decreased proximal control is associated with anterior cruciate ligament injuries[41,42] and PFPS.[43-45] Weakness of the hip abductors and external rotators is associated with poor eccentric control of femoral adduction and internal rotation during weight-bearing activities. This faulty LE pattern leads to altered shock absorption, increased ground reaction forces, and valgus torques that include femoral adduction and internal rotation and ankle eversion and pronation.[41,46-48] Several authors found this pattern to be more prevalent among female athletes and listed increased Q-angle and decreased proximal strength as contributing factors.[42-46] Incorrect movement patterning also played a role. Females exhibit greater knee extension during landing, and greater internal rotation when landing on one leg.[46] Decker et al[42] found that when landing from a jump, females compared to males, landed in a more erect posture, had greater rectus femoris activity, delayed knee flexion, and decreased eccentric gluteal activation. This faulty pattern contributes to altered shock absorption, increased ground reaction forces, and valgus torques. The authors concluded that athletes should be taught to achieve greater knee flexion during initial ground contact. This allows for a smoother landing and better transference of energy up the kinetic chain to the larger, more proximal, hip extensors. In my opinion, it is better to begin the descent into landing by flexing the hip. The legs then fold in the sagittal plane as the hip and knee extensors and ankle plantar flexors eccentrically control the landing. Hip flexion increases as the squat deepens, which prevents the knees from dropping forward. When movement is controlled proximally, extraneous movement in the transverse and frontal planes is eliminated. This pattern of movement is possible only when the trunk is balanced, aligned properly, and stabilized dynamically (Figure 1).

The literature supports an integrated approach in the treatment of low back, pelvic, hip, and LE disorders. Several researchers have stressed the importance of looking for mechanical links between the pelvis, trunk, and LEs.[40-50] This confirms what Todd advocated in 1937 when she emphasized that the focus of rehabilitation should be on "patterns of movement" instead of isolated structures or movements.[1] Geraci and Brown[49] also advocated the teaching of "patterns of movement" instead of focusing on isolated structures or movement. They concluded that successful treatment of injury and prevention of reinjury focuses on restoration of the functional kinetic chain, rather than of a specific tissue. Filipa et al[50] used the Star Excursion Balance Test (SEBT), a functional screening tool that emphasizes dynamic balance and neuromuscular control to evaluate uninjured female soccer players. Compared to controls, those who received neuromuscular training designed to "control the center of mass during dynamic activities" significantly improved their SEBT compos-

Figure 1. Proper squat mechanics.

ite scores. The authors pointed out that poor core stability and decreased synergy of the hip and trunk stabilizers decrease performance and increase the incidence of injury, especially during activities that require speed and power, and especially in females.

NEUROMUSCULAR RE-EDUCATION

Successful treatment of injury and prevention of reinjury includes the following: training of the deep muscular stabilization system, strengthening of the proximal hip stabilizers, re-education of movement patterning, and restoration of the functional kinetic chain. The body must be treated in "whole" as an architectural-mechanical structure with a musculoskeletal system governed by the nervous system. Simply put, the body must be correctly aligned, stabilized, centered, and balanced for efficient integrative action of the musculoskeletal and nervous systems. This is the basis for my neuromuscular training program, which consists of the following elements: relaxation and diaphragm breathing, centering, alignment, lengthening, and dynamic stabilization.

Relaxation and Diaphragm Breathing

Neuromuscular re-training begins with relaxation and diaphragm breathing in the constructive rest position (CRP)[2] (Figure 2). Guided imagery is used to direct change (Table 1, Table 2). It is important to begin in this manner because the body is most receptive to change when the mind and body are relaxed. The practice of good breathing mechanics, which includes efficient use of the diaphragm, energizes the body, improves posture and movement mechanics, promotes relaxation, and increases the strength and efficiency of the abdominal muscles. Patients are taught that during inhalation, the diaphragm descends as the lungs fill with air. During exhalation, the deep abdominal "girdle" muscle, the TA contracts to compress the abdominal contents, which displaces the diaphragm back up under the ribcage. Poor body alignment and improper movement patterning interfere with proper breathing mechanics. Common faulty patterns include lifting the ribcage during inhalation and pulling it downward during exhalation. These patterns interfere with the normal descent of the diaphragm, activate the accessory muscles of respiration, depress the trunk, and create muscular tension throughout the body. Diaphragm or "belly" breathing trains "centering" since the TA contracts at the end of a forced exhalation.[15,17,18,20]

Centering – Pelvic Stabilization

The center of gravity lies within the pelvis and when the body is properly aligned, the line of gravity intersects it. The pelvis is thus uniquely positioned to carry out its 3 primary functions as related to posture and movement.

- Weight support and transfer. The spinal column carries the weight of the trunk, head, and upper extremities to the pelvis, its supportive base.
- Movement initiation and control. Organized movement is initiated at the base of the upright column. Movement patterns involving the coordination of proximal, distal, and opposing segments from the head to the toes are integrated at the pelvis.
- Posture stabilization. In order to function properly in these roles, the pelvis must be stable. This stability is influenced by the many muscles that attach directly to the pelvis or indirectly via the fascia. Of prime importance are the abdominal muscles, which should be functionally trained to maintain pelvic stability and integrate movement.

Figure 2. Constructive rest position.

Table 1. Relaxation Imagery

The back of your body melts into the surface that supports it.
The back of your head melts down.
Droplets of water on the back of your neck drip down.
The area behind your shoulders melts down. The area between your shoulder blades turns into gelatin and softens downward.
The long area behind your rib cage melts down.
The area behind your low back softens down.
The area behind your pelvis broadens and melts down.
Visualize your legs hung by a rod under your knees.
Your thigh bones slide deep down into the center of your pelvis.
The front of your body melts into the back of your body and the back of your body melts into the surface that is supporting you.

Table 2. Diaphragmatic Breathing Imagery

Notice the rhythmic flow of breath in and out of your body.
Visualize the breath traveling down and up a long central axis through your torso.
Inhale through your nose and watch the breath travel down the long central axis to your pelvis.
Visualize a balloon in your pelvis filling up with air.
Exhale through rounded lips and watch the abdominal muscles on the front of your pelvis pull in and up to compress the balloon and send the air back up the long central axis and out your mouth.
Watch your inhalations deepen, lengthen and slow down as your abdomen expands. Watch the exhalations lengthen as your abdominal muscles pull in and up.

As we age, functional strength of the abdominal muscles declines due to poor posture, deconditioning, and sedentary habits. Common abdominal strengthening exercises that use the "crunch," or encourage bracing or fixing of the abdominal wall, do not build functional strength. Rather, they interfere with the function of the TA and compress the trunk by over engaging the rectus abdominis.[10] This creates muscular tension and encourages a compressed, sunken chest and forward head posture. Properly trained abdominal muscles help to maintain length of the torso as they support it in a firm cylindrical shape (Figures 3 and 4). In this manner, the abdominal muscles promote balanced, dynamic posture during all functional movements and discourage static muscle tension that interferes with postural adjustments.

Skeletal Alignment and Weight Transfer

Muscles work efficiently and joints are protected when the bones they are attached to are properly aligned. If you hang a skeleton from the ceiling and superimpose the muscles upon it, they will be in their proper resting length.[51] From this position they can act most effectively to move the bones at their joints. It is important to educate patients with the help of charts, drawings, and imagery. Patients can be taught to properly align the trunk by explaining the following: The trunk of the body is composed of units of weight organized around a plumb line or line of gravity. When these units of weight are balanced properly on top of one another, weight flows easily through them. The spinal column, made up of long, undulating curves, approximates this plumb line and the line of gravity intersects the center of gravity. The vertebral bodies can then efficiently carry the weight of the trunk to the pelvis and then to the legs (Table 3).

Lengthening

Lengthening achieves two goals: (1) a "lift" through the body to counter the force of gravity, and (2) optimal resting length and length-tension dynamics of the muscles. Resting length is defined as the length that would occur when the skeleton is well-aligned in standing.[51] Length-tension refers to the most effective length at which a muscle can exert tension to contract.[51] Even when balanced, a skeleton cannot maintain its upright alignment unless the fall of weight through its bones is countered. Todd[1] teaches that the bones are compression members that carry weight downward in accordance with the law of gravity and that this weight is countered by the upward tensile force provided by the muscles. Images to optimize a "lift" through the body include the head floats upward to position itself on top of the spine, the chest floats upward, and the abdominal muscles pull inward and upward to lengthen the front of the torso. Images must be carefully chosen to not create unnecessary muscular tension. Words such as tighten and hold should be avoided.

DYNAMIC STABILIZATION

The training presented allows for dynamic stabilization or the balancing of counterforces. Opposing the force of gravity by being balanced, centered, and lengthened, rather than holding or bracing, allows postural adjustments to take place. Postural perturbations and limb movements create reactive forces in the trunk that are equal and opposite in direction and force.[21,23] A 3-dimensional study of preparatory trunk motion during upper limb movement showed that preparatory trunk motions precede upper limb movement and are opposite in direction. The authors concluded that anticipatory postural adjustments create movement instead of simple rigidity of the trunk. It follows that stabilizing the trunk by bracing the abdomen or holding the trunk in a static manner interferes with dynamic stabilization of the trunk. Rudolf Laban (1879-1958) was a dancer, choreographer, and philosopher. He created a universal language of dance called Labanotation, which described movement qualitatively and quantitatively. Laban developed his principles of "free" or "absolute" dance whereby "the fundamental means of expression for dance were to be drawn from the rhythm of bodily movement and its spatial and dynamic components." He beautifully defined posture as "the whole body swaying slightly while 'standing still' in a figure of eight pattern in continuous, subtle fluctuation between stability and mobility to maintain balance."[52]

Several researchers have advocated neuromuscular rehabilitation to restore function following injury. Of prime importance are proximal strength and control, and proper movement patterning. This leads to dynamic stability. Dynamic stability is the ability to be balanced, stable, centered, and free to move. It is the ability to stay grounded while lengthening upward. It is the ability to activate the strong muscles of the hips and thighs, to fold at the joints and to spring into action. Dynamic stability is maintained whether at rest or when moving. It is maintained during activities that require sustained postures, such as when using a computer, when playing a musical instrument, or during activities that require com-

Figure 3. Balanced seated posture.

Figure 4. Balanced standing posture.

plex movement patterning such as tennis or ballet. Dynamic stability allows for proper movement patterning, movement like the well-trained dancer.

The following case study demonstrates application of the presented neuromuscular re-training program to the treatment of an individual with multiple chronic problems related to proximal weakness and improper movement patterning.

CASE DESCRIPTION

This patient was representative of a population of recreational exercisers who develop chronic problems that interfered with her ability to continue exercising. At the core of her dysfunction was proximal weakness and the inability to properly stabilize the pelvis. The patient was a 64-year-old female referred to the outpatient clinic by her rheumatologist. She was diagnosed with rheumatoid arthritis in 2006, which most severely affects her feet. She was otherwise healthy and enjoys recreational hiking. Her past medical history included right knee medial meniscal and bilateral carpal tunnel surgery. She presented with multiple complaints of lower extremity pain and dysfunction. The patient consented to publication of her case history and signed an informed consent form.

History

The patient presented with a primary complaint of foot pain and paresthesia, and secondary complaints of hip, low back, and leg pain. Right foot pain presented two to 3 months ago following an increase in walking on hard surfaces. Symptoms consisted of sharp, shooting pain under the head and along the shaft of her second metatarsal after walking one mile. Her most recent symptoms began 3 to 4 weeks ago. They consisted of worsening lateral hip pain, aching in her low back, and burning pain that travelled down her left posterior thigh and lateral leg. Symptoms increased with prolonged sitting and sleeping on her back and they decreased with light movement. The patient also reported the following chronic complaints: recurrent pain in the center of her low back since she was a teenager; bilateral hip pain of two to 3 years duration that presented after walking one mile, when climbing stairs, and when lying on either side; chronic right medial knee pain following meniscal surgery in 2006; a recent flare-up of constant bilateral forefoot and toe burning and tingling of a few years duration that worsened with walking, hiking, and wearing shoes; and intermittent arch cramping and tightening. Current medications included 2.5 mg of Methotrexate weekly and 2.5 mg of prednisone daily. The patient would like to participate in light to moderate walking and hiking without pain and begin a conditioning program.

Evaluation and Findings

Foot symptoms were assessed first. Tenderness under the head and along the shaft of the second metatarsal led to the diagnosis of a stress reaction or fracture. Burning discomfort with squeeze of the second intermetatarsal space was suggestive of an inflammatory response of the interdigital nerve.

Hip and leg pain were then evaluated. Standing posture analysis revealed a slouched, flat back posture with mild scoliosis. Single leg stance (SLS) was more difficult on the right. Bilateral SLS was accompanied by varus alignment of the LE and a Trendelenburg, which was greater on the right. Faulty mechanics, worse on the right, presented during SLS and repetitive squat. The knee moved forward due to decreased hip flexion and from a varus posture in extension to an internally rotated adducted position during flexion. Lumbar spinal motion was restricted in all planes except extension, which was hypermobile. Mild familiar central low back symptoms were reproduced with lumbar extension in standing, supine lying with legs extended, prone trunk raise, and during a posterior to anterior glide of the L5-S1 spinous process. The single leg raise test for sciatic nerve sensitivity was positive on the left. Supine figure of four was positive for pain in the bilateral greater trochanter, which was also painful to palpation. Manual muscle testing revealed pain and weakness in the right hip abductors and the right external rotators (4/5). There was decreased tone in the abdominal muscles, which were not active to stabilize her pelvis in standing or during manual muscle testing. Sensory test-

Table 3. Balanced Sitting Alignment

- The pelvis is vertical and balanced on the center of the two rounded bones at its base. It is neither tilted forward, causing the lower back to sway, nor tilted back causing the buttocks to tuck under.
- The lumbar curve assumes a forward curve.
- The rib cage hangs down toward the pelvis.
- The chest (sternum) floats up and the upper body widens.
- The shoulder girdle rests on top of the rib cage, the shoulders are relaxed, and the arms hang downward.
- To position the head properly, the spinal column lengthens upward through the center of the neck as the head floats upward to balance on top of it.
- The back of the neck lengthens and the chin moves gently inward.

Balanced Standing Posture

- The feet are placed directly under the thigh sockets (about six inches apart) with the toes facing approximately straight ahead.
- The knees are relaxed and in line with the thigh and ankle joints.
- The pelvis rests on top of the thighs and is neither pushed forward nor tilted back. It is supported by a gentle lift in and up by the deep, lower abdominal muscles. The buttock muscles are relaxed.
- The trunk is balanced as in the sitting posture. To avoid sitting into the heels, weight is slightly forward over the fronts of the feet.
- The arms hang long at the sides.
- The chest floats upward.
- The center top of the head lengthens upward.

ing of her feet with Semmes Weinstein filaments revealed normal sensation.

Clinical Reasoning

Foot – Her symptoms were suggestive of synovitis of the second metatarsal head and/or a stress reaction or fracture caused by overuse.

LE Radicular Pain – It was important to differentiate nerve-like symptoms in her leg from paresthesias in her feet. Low back symptoms were reproduced when extension forces were applied to the lumbar spine and left SLR was positive. It was therefore determined that leg pain was caused by low back radiculopathy and not peripheral neuropathy.

Hip Pain – The patient was diagnosed with bilateral greater trochanteric bursitis, right > left. Contributing factors include chronic low back pain, poor pelvic stabilization, weak proximal hip stabilizers, altered gait, and decreased weight bearing through the right leg due to foot pain.

INTERVENTION

Phase 1 (Sessions 1-6)

Initial treatment addressed foot pain. The patient was advised to decrease hiking activity and purchase supportive rocker-bottom hiking boots. She was fitted with total-contact accommodative foot orthoses and given nonweight-bearing foot and ankle conditioning exercises. At her second visit, two weeks later, the patient reported back, hip, and foot pain had decreased. Neuromuscular re-education was begun. Initial treatment consisted of 4, 60-minute sessions spaced 7 to 10 days apart. The patient was trained in guided imagery exercises that promote relaxation and trained in proper diaphragm breathing (see Table 1 and Table 2). Lulu Sweigard explained, "all voluntary contribution to a movement must be reduced to a minimum to lessen interference by established neuromuscular habits."[2(p6)] She pointed out that Todd first presented this concept through extensive experimentation. Her basic premise was that "concentration upon a picture involving movement results in the neuromusculature as necessary to carry out specific movements with the least effort."

The patient was also trained to "center" or stabilize her center of gravity by properly engaging the TA and thus activating the deep muscular stabilization system (Figures 5, 6, and 7). Proper skeletal alignment, dynamic stability, and efficient movement patterning was emphasized. As early as the second visit, training was applied to function, such as getting out of a chair, squatting, and balancing (Figures 1, 3, and 8). These sessions also included training to improve trunk range of motion, lumbo-pelvic coordination/mobility, and back and hip strength.

Phase 2 (Sessions 7-10)

Sessions were spaced further apart and the patient was seen for 60 minutes one time per month for 4 months. Continued emphasis was placed on dynamic stabilization, proper alignment, and efficient movement patterning. Exercises were progressed to include weight training and higher-level functional/balance activities such as step-ups, squats, and lunges.

OUTCOMES

The patient was seen 4 times in 7 weeks to treat her foot, back, and hip pain. Patient compliance with home exercises was excellent. One month following the initial evaluation, the patient reported that she was able to decrease back pain by engaging her TA, correcting trunk alignment, and by performing her home exercises. She was pleased that her hip and back symptoms had significantly decreased. Six weeks following the initial evaluation, her leg, back, and hip pain had resolved. Foot paresthesia had decreased and right knee pain was mild. Four weeks later (session 7), symptoms had not returned and right hip abductor and external rotator strength was now 5/5. Her main deficit was decreased stability during right SLS with mild right knee pain. Three weeks later (session 8), after concentrated practice of balance activities, the patient reported improved balance and resolution of knee symptoms during exercise. At her last session 8 weeks later (session 10), the patient reported continued compliance with her exercise program and improved balance and strength. Symptoms had not returned, and she was able to participate in long car trips and hike 5 miles without problems.

DISCUSSION

This patient is typical of deconditioned recreational exercisers who continue to exercise despite a LE injury. The result is compensatory movement patterning that leads to proximal weakness, dysfunction, and worsening of existing chronic problems. Numerous studies have demonstrated that proximal stability and LE mechanics influence hip function, and that when the pelvis is not supported well and/or LE mechanics are faulty, dysfunction follows.[19-35,41-46,48] The literature also supports an integrative approach to the functional treatment of this patient population, one that treats the "whole" person rather than addressing impairments. Proper alignment, efficient breathing mechanics, and proximal stability (centering) need to be trained and

Figure 5. Single knee to chest.

Figure 6. Single leg slide.

Figure 7. Active straight leg raise. Exercise coordinating diaphragm breathing with activation of the transversus abdominis.

function restored through the training of proper movement patterning. This is not a new concept. Mabel Elsworth Todd, and her student Lulu Sweigard, understood this. They elegantly presented how to most efficiently train the human body to move.[1,2] Often missed or trained improperly, however, are alignment and breathing mechanics. Poor posture and improper breathing mechanics prevent the execution of efficient movement patterning. In this article, I presented a neuromuscular re-education program that integrates the training of posture and breathing mechanics with proximal stabilization (centering) and movement patterning. The result is limb movement that is integrated into a dynamically stabilized trunk, a requirement for the restoration of proper function. This is the "art" of movement, which when combined with the "science" of movement, leads to powerful results.

CONCLUSION

The profession of physical therapy would benefit from a more artistic approach to patient treatment—one that considers shape, design, and movement patterning. Following injury or disuse, similar patterns of proximal weakness and movement dysfunction may present in many patient populations. Neuromuscular re-education of movement patterning is effective in restoring proximal stability and normal function. Guided imagery is an effective tool that minimizes the time needed to teach movement concepts to patients. Attention to balanced skeletal alignment, centering, lengthening, and efficient breathing mechanics is important to the development of efficient integrated movement patterning that can be readily applied to function.

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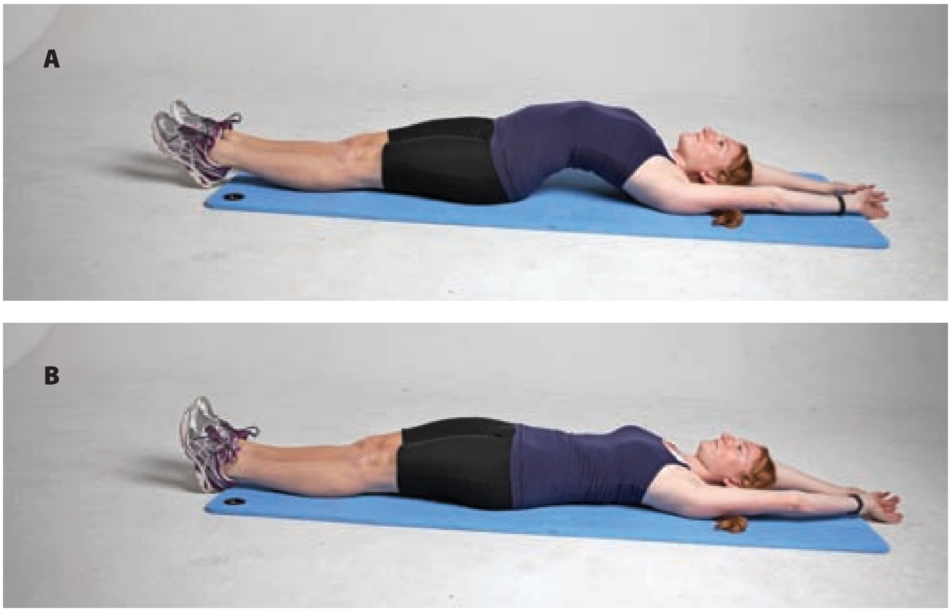

Figure 8. Chinese finger puzzle stretch A. Stretch into extension during inhalation. B. Activation of deep abdominal muscles during exhalation.

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The Effect of a Home Program for Core Strengthening on the Performance of a One Repetition Maximum Military Press

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ABSTRACT

Background and Purpose: There is minimal evidence to support the association of core strengthening and improvements in upper extremity strength. The purpose of this study was to determine if performance of a core program using a stability ball would increase the strength of the core musculature of the participants and increase their one repetition maximum (1RM) military press. **Methods:** 44 healthy individuals performed a 4-week home exercise program using a stability ball. Pre- and posttest strength assessments of their core muscles and performance of a 1RM military press were examined. **Findings:** An increase in 1RM military press and strength of trunk flexors and extensors was measured after completion of the home program. **Clinical Relevance/Conclusion:** The results suggest core strengthening may have a positive effect upon upper extremity strength. Future studies are necessary to determine the benefits of using core stabilization exercises for patients with upper extremity strength deficits.

Key Words: core training, stability ball, upper extremity strength

BACKGROUND AND PURPOSE

The term "core stability" as defined by Neumann[1] is the "muscular-based stability of the trunk." The trunk muscles work to maintain static posture of the trunk to provide postural alignment, limit excessive motion in the spine, and establish a solid base for muscles to move the extremities.[1] Core strengthening exercises of proximal and deep muscles are often used by clinicians to improve the stability of the trunk.[1-10] Core strength research has focused primarily on the treatment and prevention of low back pain.[1-8] There is minimal evidence to support the relationship of core strengthening and improvements in extremity strength.[10] Increased core strength stabilizes the lumbar spine, which is thought to provide a stable base for both the upper and lower extremities.[10,11] McGill stated "a spine must first be stable before moments and forces are produced to enhance performance."[12(p26)] McGill discussed the importance of spinal stability as being more important than spinal mobility in improving function and preventing injury. Kibler[10] expounds on this concept and extrapolates that core stability is the ability to control the trunk to optimize force and motion in terminal segments which results in "proximal stability for distal mobility." Theoretically, increasing strength in the proximal or core muscles could increase upper extremity strength. This concept is similar to the importance of scapular stabilization for glenohumeral mobility and function. The scapular muscles must provide a stable base in order for full mobility and function at the glenohumeral joint.[13]

The core musculature consists of the abdominals, lumbar, and hip musculature.[11] Each muscle group performs specific functions and works synergistically to execute specific activities. Kibler[10] described the diaphragm as the roof of the core, extending to the associated bony structures of the hips and pelvis, making up the floor. Numerous muscles in between this "roof and floor" are known as the core muscles.

Muscles of the abdomen, lumbar spine, and hip comprise the core.[1,11] The abdominals are comprised of the rectus abdominis, internal and external oblique, and transverse abdominis muscles. The abdominals contract to flex the trunk and aid in functional activities such as sitting upright, transitioning from supine to sit, and providing trunk control while standing. The lumbar musculature consists of erector spinae that is composed of longissimus, iliocostalis, and the spinalis. Also included in the lumbar spine are the multifidi, quadratus lumborum, and interspinalis. The lumbar musculature contracts to extend the trunk and assist in functional activities such as maintaining an upright posture. The hip musculature is composed of the gluteus maximus, gluteus medius, iliopsoas, and the deep external and internal rotators. These core muscles attach to the individual spinal segments and pelvis to provide stabilization necessary for the limbs to have a stable base for muscle activation and mobility.[10] Most of the prime movers for the proximal joints of the upper and lower extremities (ie, latissimus dorsi, pectoralis major, hamstrings, quadriceps, and iliopsoas) and the major stabilizing muscles for the extremities (upper and lower trapezius, hip rotators, and glutei) attach to the pelvis, ribcage, and spine as well.[10]

Core strength is necessary to provide trunk stabilization and, common to all musculature, is dependent on the rate coding and recruitment of motor units.[14] Core strengthening has been associated with prevention and treatment of injury to both the hip and lumbar spine.[4,5,7,8] Many low back disorders arise as a result of a lack of strength and endurance of the trunk muscles.[15] Inability to transfer forces generated at the core to the extremities can result in decreased efficiency or injury to the surrounding structures and musculature.[8]

Escamilla et al[16] studied the most effective exercises to improve core strength using electromyography (EMG) analysis of abdominal exercises to assess the amount of muscle activity of the abdominals, back extensors, rectus femoris, and latissimus dorsi. The study examined both traditional and nontraditional exercises. The 10 nontraditional exercises were reverse crunch inclined at 30°, Power Wheel (Monkey Bar Gymnasium, Madison, WI) roll-out, hanging knee up with straps, Ab Revolutionizer (Buckhead Marketing and Distribution, LLC) double crunch, Ab Revolutionizer oblique crunch, Ab Revolutionizer reverse crunch with weights, Power wheel knee up, Power Wheel pike, reverse crunch flat, and Ab Revolutionizer reverse crunch. The traditional exercises used by Escamilla et al[16] included an abdominal crunch and bent knee sit up. Escamilla et al[16] provided evidence to support that both the traditional exercises and nontraditional exercises were effective in targeting the abdominal musculature according to EMG results.

The stability ball is an exercise device commonly used to train abdominal muscles.[17,18] The unstable surface of the stability ball increases abdominal musculature activity.[17] Sternlicht et al[17] studied abdominal muscle activity associated with a standard crunch on an unstable surface with the ball at the level of the inferior angles of the scapula and with the ball at the level of the lower lumbar region of the back. They found that the crunch on the stability ball at the lower lumbar region showed greater rectus abdominis and external oblique activity than the traditional crunch. Marshall and Murphy[18] investigated tasks performed on a stability ball and found that they produced greater activation of abdominal musculature compared to those performed on a stable surface, thus providing additional evidence to support the use of the stability ball to more effectively target core musculature. Stevens et al[9] reported that when performing a standard crunch on a stability ball, there was greater co-contraction of the external oblique musculature and the rectus abdominis compared to exercises on a stable surface.

Strength gains can be quantified in a variety of ways.[19] One common method to measure strength is the use of a 1RM.[19,20] The 1RM is defined as the maximum load that can be lifted one time as a muscle contracts through its full range of motion.[19] In the study by Seo et al,[20] the 1RM military press was chosen as a means to quantify upper extremity strength because this maneuver requires the trunk to be unsupported during testing.

The purpose of this quasi-experimental study was to determine changes in 1RM on a military press from pretest to posttest, with an intervention of a home exercise program consisting of core strengthening using a stability ball. There is little evidence to support the association between core strength and upper extremity strength. The hypothesis of this study was that a home core strengthening program using a stability ball would increase strength of the upper extremities as measured by a 1RM military press. Additionally, we wanted to determine if the use of a stability ball for core strengthening increased the strength of the trunk flexors and extensors as measured by a dynamometer.

METHODS

Participants

A convenience study of 45 participants between 18 and 30 years of age were recruited through word of mouth from a cohort of university students. Prior to participation in the study, subjects were asked to complete a brief questionnaire to ensure that each individual had no injury or past surgery to the upper extremities, neck, or back in the last 18 months. Participants were asked to refrain from any upper extremity strengthening programs during the course of the intervention. Each subject signed an informed consent form that was approved by the university Institutional Review Board. Forty-four participants participated in pretest measurements. One participant was excluded from pretest measurements because of acute shoulder pain that was being treated with cortisone injections.

Procedures

During pretest and posttest data collection, each participant completed the 1RM military press prior to assessment of trunk flexion and extension strength. The military press was performed on a bench without back support and the subject sat with feet flat on the ground and shoulder-width apart. The dumbbells were pressed up until the arms were fully extended above the head. The dumbbell was then lowered to the start position to complete the exercise. The 1RM was performed by selecting dumbbells of appropriate weights to perform the following procedure adopted from American College of Sports Medicine protocol.[19] The protocol included the following steps:

1. Ten repetitions at 50% of subject's estimated 1RM allowing 1 to 2 minutes rest in between.
2. Three to 5 repetitions at 75% of estimate 1RM allowing 2 to 4 minutes rest in between.
3. Increase the load by 5% to 10% and attempt another 1RM lift.
4. Continue process of increasing the load by 5% to 10% and attempting 1RM lifts until the Subject can no longer lift the weight through the full range of motion using the correct technique. 1RM was determined within five 1RM attempts.
5. The same investigator performed the measurements on all participants.

Participants then performed the trunk flexion and extension strength testing phase of data collection. A Chatillon® Force Gauge was used to measure the strength of the rectus abdominis, erector spinae and internal and external obliques through isometric testing of trunk flexion and trunk extension. This device is a mechanical force gauge that rests on a metal stand on the floor. The chain, which is connected to the gauge, is then connected to a strap placed around the patient. The gauge measures the isometric tensile pull of the trunk musculature.

Trunk flexion isometric testing was done with the head of the mat elevated to 30°, which placed the subject in an optimum position to test with the dynamometer. Trunk extension isometric testing was measured with the head of the mat lowered 30° to allow for optimum testing with the dynamometer. Participants were stabilized to the mat with straps in the supine position at ASIS and 12.7 cm distal to the patella and they performed 3 trials for trunk flexion. Participants were then placed in the prone position to measure isometric trunk extension using straps at PSIS and 12.7 cm distal to the knee joint. The point of pull for the dynamometer was positioned along the mammillary line for flexion and at the spine of the scapula for extension. All readings were taken by the same investigator and the results of 3 attempts were expressed as a subject's mean score (Figure 1).

An education and instruction session was set up following the pretest data collection when participants received their stability balls and home exercise program. Each subject's height was measured in order to determine the correct size of the stability ball to be used throughout the duration of the study. The size of the stability balls ranged from 55 cm to 75 cm. Proper sizing of the stability balls was determined by measuring the angle of hip and knee flexion while the participant was seated on the stability ball. In order to determine if the ball was the correct size the participant's angle of hip and knee flexion was measured at 90°. Each participant received a stability ball in order to complete the exercises successfully.

After receiving their stability ball, participants were instructed on the proper technique for each exercise for core strengthening. The home core strengthening program was created using 6 exercises based on the EMG results from prior studies[16-18] (Table 1). One researcher demonstrated the exercises for the participants and then asked the participants to replicate the exercises. The researcher provided feedback on correct form to ensure that the individuals in the study were doing the exercises properly through self-demonstration. Participants were asked to perform each exercise 3 times a week at home for all 4 weeks of the research

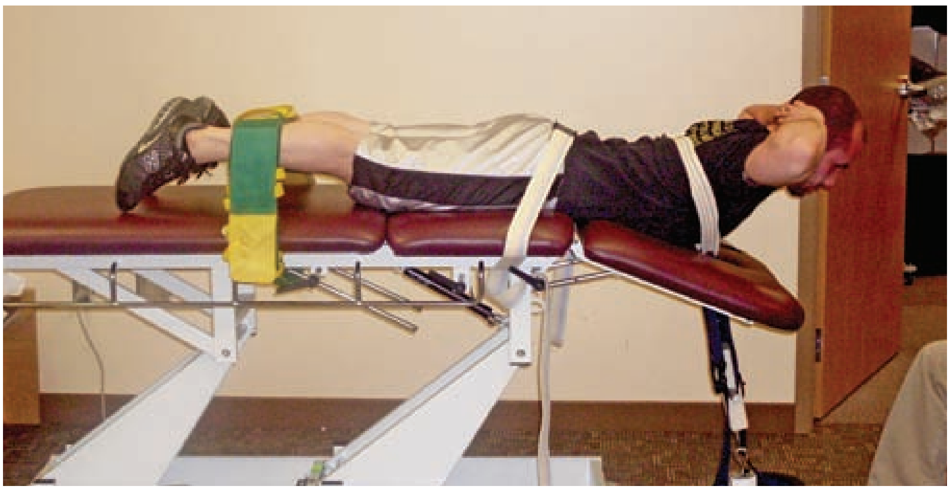


Figure 1. Isometric trunk flexion and extension test.

study. They were asked to refrain from all other exercises while they participated in this study. Progression of the exercises was based upon the participant's own perception of the amount of difficulty of each exercise. Participants were to begin with one set of 25 for phase one of each exercise. Once they were able to complete one set of 25 without difficulty, they were to progress to two sets of 25. Progression to each phase was based on the ability to complete two sets of 25 without a participant's perception of difficulty. If maximal phase was reached, participants were asked to increase the number of sets to 3 to 4 sets of 25. At the conclusion of the information session, participants received an activity log to record the number of repetitions and sets performed each day for each exercise throughout the course of the 4-week program.

DATA ANALYSIS

The means, standard deviations, and confidence intervals for 1 RM military press, trunk flexor strength, and trunk extensor strength pre- and posttest measurements were determined. The posttest data was compared with the pretest data for each outcome measure using a paired t test to determine if there were differences in strength. Statistical significance was determined by $p < 0.05$ and a 95% level of confidence. Data analysis was performed using the SPSS version 10 package (IBM; Chicago, IL).

RESULTS

Thirty-eight participants (5 males and 33 females; mean age 22.3 years old, age range 21 to 24 years with only 2 participants over the age of 25 years) completed the program and participated in the posttest data collection. The attrition rate was 13.6%. Six participants withdrew from the study prior to completing the 4-week program. No reported adverse reactions or injuries were reported during the 4-week program. All 38 participants returned their activity logs to the researchers at the time of the posttest data collection. There was 100% compliance in completion of the logs. Progression was demonstrated as both number of sets and increase in phase level were reported in the activity logs. Participants progressed at different rates through each of the phases; only one subject reached phase 4 that required performing 4 sets of the bridge exercise.

Military Press

Mean values of strength for the pretest and posttest 1RM military press can be found in Figure 2. The results of the paired t-tests for 1RM military press can be found in Table 2. The analysis of the paired-t calculations determined that the results of this study were statistically significant for improvements in 1RM of the military press. The average increase for 1RM military press was 1.1 kg (see Table 2).

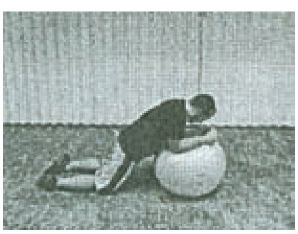
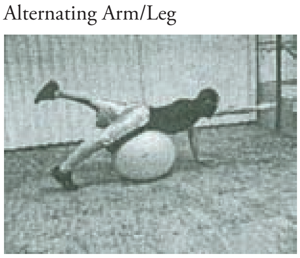
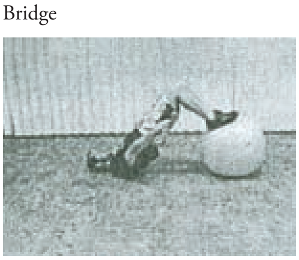
Trunk Strength

The pretest and posttest mean values for trunk flexion and extension measured with a dynamometer can be seen in Figure 2 with the results of the t test presented in Table 2. The results show a statistically significant difference between pretest and posttest data. Statistical significance was also found with regard to the results of the paired t-test (see Table 2). The p value for trunk flexion ($p = .000$) was lower than the established alpha level of 0.05. The average increase in trunk flexion strength was 4.5 kg (Table 2). The p value for trunk extension ($p = .005$) was lower than the established alpha level of 0.05. The average increase in trunk extension strength was 4.2 kg (see Table 2).

DISCUSSION

The results suggest that an increase in trunk flexion and extension strength after participation in a 4-week home core strengthening program coincides with an increase in 1RM military press performance. Because there is very little research available regarding the association of core strength and upper extremity strength, this study provides preliminary evidence to support the hypothesis that increase in trunk (core) strength can increase upper extremity strength. There was an increase in isometric trunk core strength of the trunk flexors and extensors when measured with a dynamometer. Since no other exercises except core stability exercises were performed by the participants, the results suggest that the documented improvement in the 1RM military press is due to the improvement in the trunk strength.

Table 1. Core Stability Ball Exercise Program

Exercise	Phase I	Phase II	Phase III	Phase IV
Standard Crunch on Ball 	Position: Ball at level of inferior angles Reps: 25 Sets: 2	Position: Ball at level of lumbar spine Reps: 25 Sets: 2	Position: Same Reps: 25 Sets: 3	Position: Same Reps: 25 Sets: 4
Superman 	Position: Arms folded across chest Reps: 25 Sets: 2	Position: Shoulders in full flexion Reps: 25 Sets: 2	Position: Same Reps: 25 Sets: 3	Position: Same Reps: 25 Sets: 4
Pike 	Position: Bent Knee Reps: 25 Sets: 2	Position: Straight Knee Reps: 25 Sets: 2	Position: Same Reps: 23 Sets: 3	Position: Same Reps: 25 Sets: 4
Rollout 	Position: Elbow Flexed Reps: 25 Sets: 2	Position: Same Reps: 25 Sets: 3	Position: Same Reps: 25 Sets: 4	Position: Same Reps: 25 Sets: 4
Alternating Arm/Leg 	Position: Knees Flexed Reps: 25 Sets: 2	Position: Knees extended Reps: 25 Sets: 2	Position: Same Reps: 25 Sets: 3	Position: Same Reps: 25 Sets: 4
Bridge 	Position: Knees extended; arms on the floor Reps: 25 Sets: 2	Position: Knees extended; lift arms off floor Reps: 25 Sets: 2	Position: Knees bent; arms on floor Reps: 25 Sets: 2	Position: Knees bent; lift arms off floor Reps: 25 Sets: 2

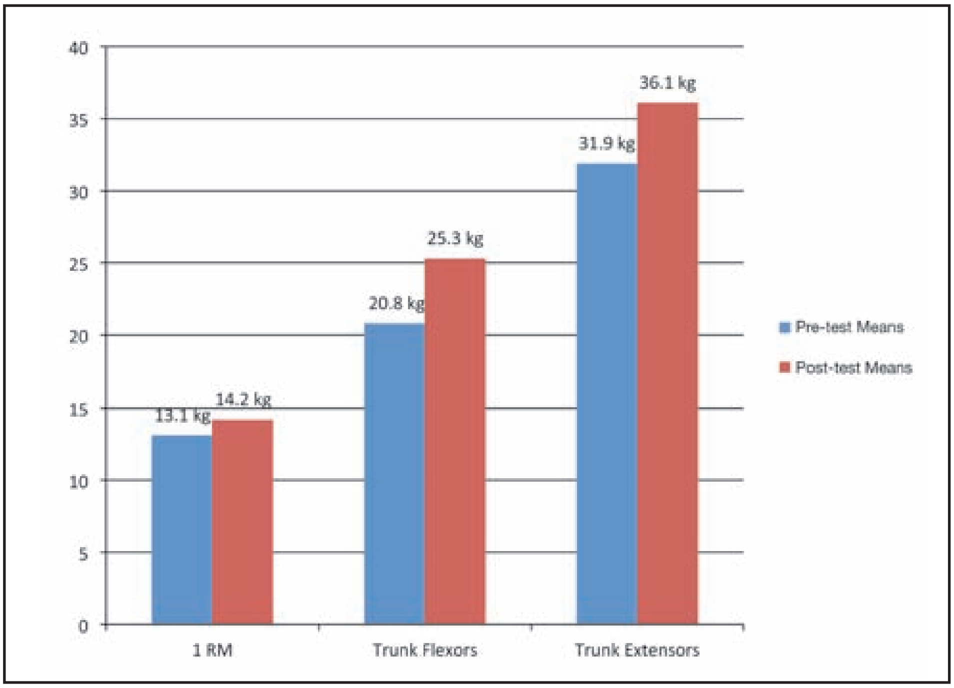


Figure 2. Comparison of pre- and post-test means of strength gains.

The exercise program developed for this study was based on the results of Escamilla et al[16] for selecting exercises that target the core muscles. Our findings are similar to the conclusions of Sternlicht et al[17] and Marshall and Murphy[18] whose research supported the benefits of core strengthening using a stability ball. Sternlicht et al[17] reported upper and lower portions of the rectus abdominis and external oblique demonstrated greater EMG values when using a stability ball compared to a traditional crunch. They also found that the position of the ball on the spine also affected EMG values. The ball placed at the level of the lower lumbar region of the back demonstrated increased muscle activity compared to the ball placed at the level of the inferior angle of the scapula. Based on this study, our participants progressed from positioning the ball at the level of the scapula to the level of the lumbar region. Our study supports the findings of Sternlicht et al[17] by demonstrating an increase in trunk flexor strength using the stability ball.

Marshall and Murphy[18] compared 4 different exercises on and off a stability ball including inclined press-up, upper body roll-out, quadruped, and single-leg hold. An EMG was used to measure the muscle activity of the external obliques, erector spinae, rectus abdominis, transverse abdominis, and internal obliques. They concluded that performance of exercises on the stability ball resulted in an increase in muscle activation of these muscles and those specific exercises involved different synergistic relationships between the muscles that are important for core training. Our study supports the findings of Marshall and Murphy[18] because our selected exercises on the stability ball demonstrated an increase in both trunk flexor and extensor muscle strength.

Several limitations of this study should be identified. One limitation of this study is that the core strengthening program was administered through the use of a home exercise program. Participants were not monitored throughout the program to ensure full compliance with the home program or to determine if all exercises where being performed correctly. Each participant was asked to complete and return a daily exercise log; however, there was no method to ensure these reports were accurate. Secondly, there was no control group. A future study could have both a control group and exercise group to better support the findings. Attrition may be a factor in the results. Six out of the 44 participants did not complete the 4-week program. Additionally, every attempt was made to standardize the measurement of the 1RM; however, better stabilization of the trunk and reliability values of the measurement of strength would be beneficial. Finally, some of the core stability training exercises incorporated upper extremity activities, including weight bearing through the upper extremities with the pike and rollout exercises. Active shoulder flexion was performed with the superman exercises and alternating arm/leg lift. The possibility that these activities may have also been a contributing factor in improvement in the 1RM cannot be discounted.

CONCLUSION

The results of this research study demonstrate that core strength can be increased through the use of exercises on a stability ball. This study supports two prior studies in which exercises using the stability ball targeted core stabilizers, including both trunk flexors and extensors.[17,18] This study also demonstrates an increase in 1RM strength for the participants who completed in a 4-week core stabilization program using the stability ball at home. The study suggests that the use of a core strengthening program may be beneficial during upper extremity rehabilitation because of the positive effect that core strengthening had on upper extremity strength. Future studies using more a more rigorous design methodology are necessary to determine the benefits of incorporating core stabilization exercises in the rehabilitation of patients with upper extremity strength deficits.

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Table 2. Pre- and Post-strength Testing Mean Differences

	N	Mean Difference	Standard Deviation	95% CI Upper	95% CI Lower	t	df	Sig. (2 tailed)
Pretest posttest 1RM	38	1.1 kg	1.7 kg	1.7 kg	.6 kg	4.161	37	.000 *
Pretest Posttest Trunk Flexor Strength	38	4.5 kg	5.8 kg	6.4 kg	2.6 kg	4.77	37	.000 *
Pretest Posttest Trunk Extensor Strength	38	4.12 kg	8.7 kg	7 kg	1.3 kg	2.96	37	.005*
* Indicates significance and p < .05 level								

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Injuries in Irish Step Dancing: Descriptive Case Series Review

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ABSTRACT

Background: World level dancers practice 6 to 7 days a week for 2 to 3 hours per day exposing them to multiple injuries. **Purpose:** To present an evaluation and exercise program for dancers to reduce impairments from over pronation of the foot that may cause hip compensation. **Methods:** Eleven female world competitors, ages 10 to 22 consented to anonymous utilization of physical therapy data. **Findings:** The results of a paired t test found a significant difference from initial findings to post-exercise program p = 0.007, indicating a reduction of impairment post exercise. Even though the dancers still presented with pronation, the physical therapy intervention proved effective in returning the dancers to competition. **Clinical Relevance:** This study adds to the limited clinical research in exploring reduction of overuse in this group. **Conclusion:** A comprehensive physical therapy examination is important to design an appropriate individualized exercise program. Correcting the imbalances caused by pronation may improve muscle function and thus reduce the compensation of the hip.

Key Words: ankle, hip, step dancer

INTRODUCTION

The sport of Irish step dancing has recently gained popularity, even though it has been around for the last 42 years. Championship level Irish step dancers compete in major tournaments that consist of regionals where approximately 17,000 female dancers from around the globe qualify.[1-12] The 2012 Annual World Competition had roughly 2,600 female step dancers.[13] This style of dance requires substantial strength in the core and lower extremities due to the quick leg movements and footwork, without movement of upper extremities.[14] World level Irish step dancers train 6 days a week for two to 3 hours each day, predisposing them to overuse injuries.[14-16] This is consistent with Wilder and Sethi[17] who stated that 50% of all sports injuries are from overuse. In their study of overuse injuries, they discussed the principle of transition in overuse injuries to connective tissue, whereby repetitive microtrauma leads to local tissue damage as an athlete increases the intensity and duration of training. This damage to the connective tissue without proper rest can lead to major injury.[16-18] Damage to connective tissue can be categorized by postural changes, decreased flexibility, loss of strength, and decreased function.

The two types of shoes (ie, soft and hard shoe) required in Irish dancing do not provide support to the foot and ankle. The soft shoe, or ghillie, is similar to a ballet slipper, except for the laces, which cross the dorsum of the foot and tie around the Achilles tendon.[14,15,19] The hard shoe, comparable to a tap shoe, has a fiberglass toe box and heel that are about ¾ of an inch wide and 1.5 inches thick. The rest of the shoe is soft leather, allowing the foot to obtain a pes cavus position when the ankle is fully plantar flexed and the knee is extended. The goal, when dancing in the hard shoe, is to be powerful, loud, and rhythmical. This goal places a heavy load on the lower extremity.[14,15,19] Throughout a dance routine, Irish step dancers constantly alternate at a rapid pace between pronation and supination of the foot and ankle. Pronation and supination motions are described as tri-planar.[20,21] Pronation (Figure 1) of the foot incorporates abduction, dorsiflexion, and eversion. Supination is a combination of adduction, plantar flexion, and inversion. If muscle imbalances occur, these motions do not properly occur and may contribute to lower extremity injury.[20,21]

Irish dancers mostly dance "on toe" (Figure 2). This position is described as full ankle plantar flexion with the knees extended and toes at 90° of extension. The literature suggests that injuries such as stress fractures could arise in the forefoot due to increased pressure on the metatarsal heads and the calcaneal physis in this position.[14,19,22] "On toe" can be compared to revele in ballet where the windlass action is exaggerated as the subtalar joint supinates and forefoot extends maximally. Ahonen[20] reiterated that the plantar aponeurosis tightens with extension of the toes. The peroneus longus acts with the flexor hallucis longus to cause first ray plantar flexion, creating a rigid lever to push off. The posterior tibialis is also working to support the medial arch in supination to allow the gastroc soleus to aide in raising the heel.[23,24] Thus, during the transition to foot flat, the posterior tibialis will eccentrically contract and the hip extensors and external rotators will aid in the smooth return of the foot to the ground.[20,25-27] If the alignment of the foot is altered, an unnatural turn out may occur causing the foot to loosen and pronate instead of supinate (Figure 3). This faulty postural alignment could relate to an increase in calcaneal eversion/pronation (Figure 4), which may cause an insufficient contraction of the posterior tibialis as well as loss of balance at the hip.[23,24] It has been documented in multiple studies that calcaneal valgus/eversion contributes to a shortened Achilles tendon and a position of pronation.[19,22,24,28] When the static measure of weight bearing calcaneal eversion is greater than 7°, postural changes in the lower extremity occur.[20,29]

Another movement, called "toe walks" (Figure 5), is similar to en pointe in ballet and is an extension of the movement "on toe."[22] In this position, the flexor hallucis longus muscle is in action due to the slight toe flexion of the interphalangeal joint. The step dancers begin toe walks at the age of 12 because the International Council of Irish Step Dancing felt that at this age, dancers have sufficient strength in their core, foot, and ankle musculature. Research has shown that at age 12, kinesthetic memory begins and coordination of this type of activity can be learned.[19] In "toe walks," dancers balance their entire body weight on the tips of their toes while in their hard shoes. This movement increases the stress along the metatarsals and phalanges due to the slight toe flexion that is required.[14,22,30]

One of the common steps in a 1½ to 2 minute performance is a "leap over" (Figure 6), in which the dancer may be two feet or higher in the air. It has been shown that dancers absorb 6 times their body weight while landing from these types of jumps.[19] The position of the push off leg is in slight

Figure 1. Pronation/valgus.

Figure 2. On toe.

Figure 3. Turn out.

Figure 4. Calcaneal eversion.

Figure 5. Toe walk.

hip and knee flexion while the ankle is in plantar flexion. Dancers land across the midline of the body in external rotation of the hip, full knee extension, and plantar flexion of the ankle. The gluteus maximus aids in the control of the land or deceleration of the body, and the medius assists in balancing the pelvis and lower extremity.[25,27,31] As dancers land on toe and decelerate into a foot flat position, forced pronation to maintain external rotation of the hip may occur. The loss of external rotation of the hip may be related to tightness of the iliopsoas muscle group, which acts as an internal rotator on the weight bearing leg.[26,32,33]

Another important maneuver in this genre of dance is "the rock" (Figure 7). According to May and Shippen,[34] the contact force of the ankle with the ground during the rock may be 14 times the dancer's body weight due to muscle contractions. In this step, while on the balls of their feet, dancers invert and evert both ankles simultaneously, causing a weight shift from one hallux to the other.[34] The peroneal muscle group laterally and the anterior and posterior tibialis medially are also working to generate enormous strength and flexibility to control the entire body weight of dancers. This step has been demonstrated to cause injury to the Achilles tendon as well as 5th metatarsal stress fractures, ankle fractures, or inversion sprains due to the maximum force required to perform this maneuver.[19,34]

A majority of studies have focused on describing the most common injuries Irish dancers face. Noon et al[14] described the most common injuries diagnosed in Irish step dancers. Many of the dancers in this case study are presented with multiple injuries, primarily of the knee and ankle.[17] McGinness and Doody[15] studied 159 male and female dancers, ages 15 to 24. They found that 79% of the dancers possessed more than one injury. Furthermore, 32% had ankle injuries, 25% had foot injuries, ankle sprains occurred in 29%, foot stress fractures in 12%, and soft tissue hip injuries in 12%. A cohort study by Walls et al[19] consisted of 18 subjects; 8 male professional dancers and 10 female professional dancers with the right ankle evaluated by an MRI. This study focused on overuse injuries, consisting mainly of Achilles tendinopathy and degenerative changes in the ankle joint.

CASE REPORT

The purpose of this descriptive case series was to determine if a pronated foot position leads to biomechanical changes of the lower extremity, to identify appropriate tests and measures, and develop an exercise program that would reduce impairments in order to return the dancer to World or Championship level competition. A thorough clinical examination of the posture of the foot, flexibility, strength, and functional ability related to Irish step dancing may be helpful to the treating clinician. McPoil and Cornwell[29] "noted that an entire examination of the lower extremity is required to rule out pathology in the proximal and distal joint that could affect dynamic movement."

METHODS

Participants

Nineteen patients, who met the inclusion criteria of female Irish step dancer, world level or championship competitor,

Figure 6A. Pre-leap over.

Figure 6B. Leap over.

Figure 7A. Pre-rock.

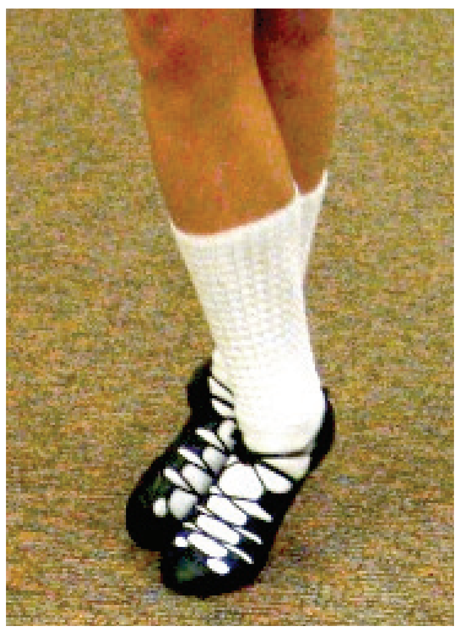

Figure 7B. End-rock.

and previous or recurring lower extremity injury, were asked to participate in the study. Patients who had undergone any lower extremity surgical procedures were excluded from the study.

Eleven subjects from 5 different Irish step dancing schools, ages 10 to 22, consented to anonymous utilization of data from physical therapy sessions that included detailed chart reviews. Of these 11 subjects, 18 different conditions were treated. Some subjects presented with a single injury and others with multiple injuries. Ten of the subjects agreed to return between 3 and 17 months after initial measurements for a follow-up examination. The body types of these dancers resembled the lower extremity of a gymnast. None of the dancers had a BMI of over 25.

Institutional Review Board approval was granted by Winthrop University Hospital, Mineola, NY, and the rights of the subjects were protected.

PROCEDURE

Data was obtained through a detailed chart review of each subject's physical therapy care from initial evaluation to discharge, last progress note written, and follow-up summary. The ReDoc 7.5 computerized physical therapy rehabilitation note writing documentation system was used. The authors performed all test procedures. Data from the original and follow up measurements were analyzed for normality using the Shapiro-Wilk test.

TESTS AND MEASURES

Anterior and posterior postural assessments were done using a plumb line. The anterior view was used to observe a pronated or supinated subtalar joint position. The posterior view was used to observe calcaneal valgus.[35,36] Range of motion measurements of dorsiflexion with the knee flexed and fully extended were recorded in a non-weight bearing position in order to assess for gastrocnemius-soleus flexibility. A standard baseline goniometer was used. For the purpose of this study, we considered measurements of 12° of ankle dorsiflexion or less with the knee flexed to be a limitation. The normal measurement is 20°. When testing dorsiflexion with knee extension, we considered measurements of 5° or less, compared to normal which is 10°, a limitation.[28,36,37]

Goniometric measurements for gastrocnemius-soleus flexibility (Figure 8) were taken according to the alignment described by Norkin and White.[37] At the final follow-up, the measure of calcaneal eversion was added to demonstrate a numerical measure to assess pronation. A goniometer was used to measure calcaneal eversion in a standing position. The stationary arm of the goniometer bisected the Achilles tendon and the moving arm bisected the calcaneus.[20,29,38] Measurements greater than 7° were a considered a positive finding for pronation of the subtalar joint.[20,29]

Muscle strength testing was performed according to positions, stabilizations, and grades described by Kendall and colleagues.[35,36] Testing was performed against gravity. For the purpose of this study, a manual muscle test grade of 4/5 or less was considered a muscle weakness. Manual muscle testing of the posterior tibialis (Figure 9) was performed with the subject in supine with the involved lower extremity in neutral, resistance given against the patient in plantar flexion and inversion. The flexor hallicus longus was tested (Figure 10) with the subject in the supine position with the ankle in neutral, manual resistance given against flexion of the interphalangeal joint of the great toe. The strength of the hip flexors (Figure 11) was assessed in a seated position. The hip extensors (Figure 12) were assessed

Figure 8. Measurement of gastroc/ankle flexibility.

Figure 9. Posterior tibialis strength assessment.

Figure 10. Flexor hallucis longus strength assessment.

prone with the knee bent to avoid substitution from the hamstrings. The hip abductors (Figure 13) were assessed in sidelying with knee extended and hip slightly extended and externally rotated.[36]

Functional assessments relevant to this population of subjects were the single heel raise (Figure 14) and single hop tests (Figure 15). These tests indicate whether the subject had the necessary strength to obtain the "on toe" position. The single heel raise served to measure the functional strength of the posterior tibialis because it has to stabilize the foot in supination to allow the gastroc-soleus complex to aide in plantar flexion of the foot/ankle.[23,24] In general, to perform a single heel raise; one must have between 55° and 60° of extension of the great toe as well as full plantar flexion of the foot/ankle. For dancers, it is expected that they have 90° of great toe extension.[19,22] Subjects were tested in standing and asked to raise the heel completely off the floor. Subjects were not allowed any stabilization for balance.[23,24,39] The subject was considered unable to perform if observation showed that the involved extremity did not achieve the same height as the uninvolved extremity (Figure 16).

The single hop test determines the ability to push off the foot. Subjects were tested in standing and asked to hop off the ground on the involved foot. Again, no stabilization for the upper body was allowed.[27,31] A dancer was deemed unable to perform if observation showed that the subject did not achieve the same height of the uninvolved extremity. For those with bilateral conditions, use of the upper extremity or substitution was assessed by the therapist and graded as unable to perform.

RESULTS

The initial results reflect the 11 subjects (N=11) with 18 total conditions that were treated over a two-year period. Four of the subjects were 12 years and younger (36.4%), 6 of the subjects were 13 to 16 years old (54.5%), and one of the subjects was 22 years old (9%). The results of the clinical examination for the involved extremity and for cases of bilateral pathology, the more painful and limited extremity are presented.

Table 1 describes the subjects, ages at the time of injury, case numbers, and the conditions in which they presented. Table 2 shows the number of subjects who had 1, 2, or 3+ conditions treated. Table 3 breaks down the percentage of specific conditions treated. Subjects were grouped in accordance with their conditions. Table 4 breaks down the conditions the subjects presented with along with the clinical findings that were relevant to the functional abilities of this population. We calculated the total percentage of the 18 conditions. Initially not all subjects received the same tests and measures. As they returned with other pathologies, we began to notice a pattern of injury that warranted further testing. Therefore, we calculated the percentage based on the total amount of conditions tested. Table 5 depicts 10 of the 11 subjects who returned for follow-up testing. We tested for the original 9 clinical findings to determine if those findings continued. Table 6 is a calculation of the percent incidence of the clinical findings, as well as the comparison (percent of change) to the follow up findings.

A Shapiro-Wilk test evaluated the normality of distribution in the population of 11 dancers using an alpha = 0.05 level of significance, based on the percent of change of impairments before and after physical therapy intervention. The Shapiro-Wilk test resulted in a $p = 0.36$ level of significance, which is not significant ($p > .05$), and fails to reject the null hypothesis. Therefore, the data collected are from a normal distribution. The sample mean of our data set from 0 indicated no overall change. The paired t test found a significant difference from initial findings to post exercise program, $p = 0.007$, indicating a reduction of impairment. The average change was a 21.3% decrease in ability; therefore, the posttests resulted in fewer occurrences of impairment after physical therapy treatment. Based on these findings, the physical therapy care had positive effects on the change in gastroc soleus flexibility and on the strength of the ankle and hip in a nonweight bearing position. There was no change for 10 of the follow-up subjects with pronation/calcaneal eversion. Since returning to competitive dance, the subjects continued to demonstrate limitations with full range of motion of the involved lower extremity during a single heel raise and single hop tests.

DISCUSSION

The goal of this case series was to discover the cause of Irish step dancers' recurring injuries. We felt there was a relationship between the length of practice time and the injury to the lower extremity. As the population grew in our facility, we discovered a pattern of biomechanical issues. We noted an incidence of hip pathology in addition to reoccurring injury of the foot and ankle. Due to the present published reports that lacked a clinical exam correlation, we felt this study would be a useful tool for injury assessment and prevention of step dancers.[15,19]

The initial postural assessment showed that 94.4% of the conditions, or 90.9%

Figure 11. Position used to measure hip flexion strength.

Figure 12. Hip extension strength assessment.

Figure 13. Position used to measure hip abduction strength.

of the subjects, demonstrated pronation and calcaneal valgus (Table 4). The limited flexibility of the gastroc soleus complex or lack of dorsiflexion was present in 100% of the subjects. These findings represent the odds of previous studies, suggesting that loss of dorsiflexion limits frontal plane motion in the talocrural joint causing the subtalar joint to compensate in the transverse plane leading to overpronation.[17,33,38,39]

Biomechanically, the position of pronation/calcaneal eversion will cause the talus to produce a medial and downward translation of the navicular.[40] The posterior tibialis tendon then becomes lengthened over time due to its attachment on the navicular. This in turn alters the length tension relationship, which provides a weakened state for the posterior tibialis. In this population, this muscle plays a major role in supination of the foot during quick loading movements on toe and pushing off to jump. When this muscle becomes weak, the dynamic control of the arch for supination, especially during loading of the foot, is hindered.[17,23,39,40] Our results found that all subjects presented with weakness of the posterior tibialis.

Calcaneal eversion/pronation also increases the force that is absorbed in the metatarsal region and may lead to dysfunction in that area. We question if this force may be a reason that metatarsal fractures occurred in cases 1 and 2. Wilder and Sethi[17] suggested that stress fractures occur when the bone cannot adapt to the load placed upon it during activity. The pronated position of the foot in addition to limitation in dorsiflexion may predispose one to metatarsal stress fractures.[17,33,38,39]

Our interest in the muscles that assist the posterior tibialis with inversion and plantar flexion of the ankle warranted further investigation of the medial side of the foot. This led us to test the strength of the flexor hallucis longus (FHL) muscle (Figure 10). The FHL muscle is one of the largest and strongest of the deep leg muscles. Its greatest action is from foot flat to en pointe, or the aforementioned "toe walks."[42,43] The FHL muscle acts as a rigid lever to plantar flex the first ray and control body weight when the ankle is in plantar flexion, as noted during "on toe."[43] The FHL muscle in this position carries at least 3 times the body weight of the dancer.[14,22,44] Molnar et al[22] described that when dancers jump, the muscles of the medial ankle compartment concentrically contract with forceful hallux push off in order to rise up on their toes and eccentrically contract upon the floor to absorb the load. The flexor hallicus longus is constantly stressed during dancing due to rapid extension of the interphalangeal joint. If the muscle is weak or lengthened, it cannot perform these actions correctly and therefore will be at risk for overuse injury.[43,45] Only one subject did not demonstrate subtalar pronation/valgus and consequently, presented with a weak posterior tibialis muscle but a strong flexor hallucis longus on the involved side.[36,46]

In regard to soft tissue injuries of the hip, further investigation of the results led us to conclude that the position of pronation/calcaneal valgus greater than 7° can lead to internal rotation of the tibia causing internal rotation of the femur.[20,29,38] This position causes the femoral head to sit posteriorly in the acetabulum.[47] The posterior fibers of the gluteus medius may be stretched resulting in a biomechanical disadvantage for contraction of the hip abductor musculature system.[16,25] The posterior fibers of the hip abductors, gluteus medius, and gluteus maximus work together to extend the hip.[25,35,36] Bullock-Saxton[48] discussed that weakness can occur in the hip extensors following an ankle injury. Our findings support these phenomena with 100% and 84.6% of those tested having weakness in the hip abductors and extensors. That weakness may alter the mechanical ability to decelerate the lower extremity during jumps, leading to overuse injuries of the hip and the foot with the turn out required during the land.[49]

When the femur is in a position of internal rotation, the pelvis will compensate into a position of anterior tilt (ie, anteversion). In addition to lengthening the hip abductors, this also shortens the iliopsoas muscle.[47] One study suggested that due to the insertion of the iliopsoas, it might act as an internal rotator in a weight bearing position.[48] If the iliopsoas is tight or inflamed, it may restrict

Figure 14. Single heel raise assessment.

Figure 15. Single hop.

Figure 16. Unable to complete heel raise.

hip external rotation or the turn out needed on the standing leg.[16,18,32] A prolonged shortened state of the iliopsoas muscle leads to insufficiency, and therefore, an inability to optimally flex the hip. While dancers contract the hip flexor musculature in this state, they are at risk of apophysitis at the ASIS.[40,49,50] Our findings suggest those could be the biomechanical reasons why 100% of dancers tested also had weak hip flexors.

As described in the introduction, there are specific maneuvers and explosive movements of the lower extremities that are required of this athletic population. Due to these demands, the subjects were also asked to perform functional movements about the foot/ankle and hip.

The results of the single heel raise showed that 10 of the subjects (ie, 94% of the conditions) were unable to complete it compared to the uninvolved extremity (Figure 15). In those cases of bilateral extremity pain, upper extremity assistance to complete the activity was required or postural sway was noted. Again, the biomechanical finding of calcaneal valgus/pronation may contribute to a lengthened posterior tibialis, thus insufficiency of the muscle. The inability of this muscle to perform correctly altered the ability of the subtalar joint to supinate in order to lock the foot. This does not allow for normal action of the gastroc soleus complex to plantar flex the foot and ankle completely.[22-24,39] We felt this functional assessment most closely mimicked the repeated ballistic maneuvers performed by these dancers "on toe." We also tested the ability of each subject to perform a single hop. Since jumping and landing requires the use of all lower extremity musculature, which presented with the previously described imbalances, 100% of the subjects were unable to perform the hop. The hip musculature comes into play, especially the gluteus maximus, which is a hip extensor and external rotator, and it works in concert with the gluteus medius posterior fibers.[35,36] The hip extensors are responsible for deceleration or an eccentric contraction during landing from the jumps and leaps performed.[27]

The dancers are expected to land from a jump with the hip in full external rotation across midline, which is limited due to the previously described imbalance at the hip caused by pronation. Tight calf muscles also hinder the ability to land. Loss of flexibility in the calf restricts dorsiflexion at the ankle, which decreases the capacity for shock absorption when landing, thus predisposing dancers to calf muscle strains, fractures, and Achilles tendonitis.[28,32,33] It has been documented that at least 10° of dorsiflexion is required to accept forces from a leap or jump, which none of these dancers demonstrated.[28,36] This may suggest the reason for ankle/foot and hip injuries coexisting in this population of athletes.

From our examination, an individualized exercise program was developed, which included the following: stretching of the gastro soleus complex, graded strengthening program to the hip extensors, flexors, abductors, core, posterior tibialis, and flexor hallucis longus. They were progressed to heel raises supported, then unsupported, and eccentric gastro soleus exercises. Once dynamic proprioceptive balance activities were mastered, plyometrics were implemented. The dancers received a home exercise program to maintain the functional ability achieved in physical therapy. They were instructed to perform strengthening exercises 3 times a week and flexibility daily. When these dancers were discharged from care, 10 of the 11 were able to return to world competition level and perform steps required for their performances including "on toe."

Based on the results for the involved extremities (Table 6), physical therapy intervention was positive for a percent change in many of the nonweight bearing categories. The weight bearing structural position of pronation/calcaneal eversion did not change, as well as the ability to fully perform the single heel raise and hop. During the follow-up, the dancers were asked whether they performed their home exercise program. Most reported they were compliant with stretching of the gastrocnemius and soleus

Table 1. Subjects, Ages, Case Numbers, and Conditions

Subject	Age	Case	Condition
Subject 1	10	1	Left 1st metatarsal fracture 2010
	11	2	Left 1st metatarsal fracture 2011
	12	3	Bilateral hip pain
Subject 2	22	4	Fracture left 5th metatarsal with lateral ankle sprain
	22	5	Left sesamoiditis
Subject 3	10	6	Bilateral Achilles tendonitis/hamstring
	10	7	Left Achilles tendonitis
	11	8	Bilateral hip pain bilateral Achilles tendonitis
Subject 4	12	9	Left bimalleolar fracture
Subject 5	15	10	Flexor hallucis tendonitis bilateral
Subject 6	13	11	Right hamstring tendonitis and apophysitis of hip
Subject 7	16	12	Left anterior superior iliac spine stress fracture
	16	13	Right sesamoiditis (recurring fracture)
Subject 8	14	14	Calcaneofibular ankle sprain right
	15	15	Left peroneus brevis tendinosis and stress fracture
Subject 9	12	16	Left sesamoiditis
Subject 10	15	17	Left sesamoiditis
Subject 11	15	18	Left hip pain

Table 2. Number of Subjects who Had One or More Conditions

Number of Conditions	Number of Subjects	Percent of Total Subjects
1	6	54.5
2	3	27.3
3+	2	18.2

Table 3. Percentage of Subjects who Demonstrated the Following Conditions (N=11)

Conditions	# Subjects with Condition	Percent of total subjects
1st Metatarsal Fracture	1	9.0
Sesamoiditis/Fracture/Flexor Hallucis Longus	5	45.5
Achilles Tendonitis	1	9.0
Hip Injury Only	4	36.4
Hip Plus Ankle/Foot	1	9.0
Ankle Sprain/Bimalleolar or 5th Metatarsal fracture	3	27.3

muscle groups. Ten of the subjects continued to present with pronation and increased angle of calcaneal eversion in standing. The flexor hallucis longus strength did improve but not enough to enhance the stability of the mid foot. Hip flexion and extension (see Figures 11 and 12) did improve significantly with exercise, but weakness still was apparent for the hip abductors. We theorized that the pronated position of the foot and an increased calcaneal eversion angle can lead to a lengthened position of the gluteus medius due to internal rotation of the lower extremity, resulting in hip weakness.[20,29,39]

In summary, 10 Irish step dancers were able to return to championship level competition after physical therapy intervention. However, it was observed during the follow-up visit that these dancers were unable to perform a complete heel raise or on toe position compared to their uninvolved extremity, after return to their training regimens and noncompliance of the strengthening portion of the home program. But we cannot overlook the influence of the pronated foot on posterior tibialis, possibly causing insufficiency due to its lengthened position.

CONCLUSION

The primary purpose of this study was to discover the reason for recurring injuries in Irish step dancers and the biomechanical relationship to the repetitive movements involved. The secondary purpose was to determine appropriate tests and measures to link the distal to proximal postural malalignments in the lower extremity. The final purpose was to develop an exercise program for injury reduction. Our findings suggest the importance of a complete examination of the lower extremity to determine the proper physical therapy treatment. Due to the strenuous nature of this type of dancing and pressure at the elite competition level, it is imperative for these dancers to receive proper exercises and to comply with their home program. The percent change showed improvement in gastrocnemius flexibility and strength of the ankle and hip musculature. However, the structural finding of pronation/calcaneal eversion continued along with the inability to fully complete a single heel raise and single hop. It is the authors' hope that others will research and discover a way to reduce the angle of calcaneal eversion in weight bearing. This could lead to longer performance at elite levels with injury reduction.

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Table 4. Findings for each Condition (see Table 1 for reference to subject N=11) 18 conditions in Total

Condition/Injury	Case #
1 1st Metatarsal Fracture	**1,2**
2 Sesamoiditis or fracture/Flexor Hallucis Longus	**5,10,13,16,17**
3 Achilles tendonitis	7
4 Hip problem only	**3,11,12,18**
5 Hip plus ankle/foot	**6,8**
6 Bimalleolar fracture/ankle sprain/5th MT fracture	**4,9,14,15**

Condition and # of cases	Pronation/ Valgus	Gastroc Flexibility	Posterior Tibialis Strength	FHL Strength	Hip Flexion Strength	Abduction Strength	Extension Strength	Single Heel Raise	Single Hop
1 (2)	Yes	Limited	Weak	Weak	1-Not tested	1-Not tested	1-Not tested	Unable	Unable
2 (5)	Yes	Limited	Weak	Weak	5,10-Not tested 13,16,17-Weak	5,10-Not tested 13,16,17-Weak	5,10-Not tested17 Strong 13,16-Weak	Unable	Unable
3 (1)	Yes	Limited	Weak	Weak	Weak	Weak	Weak	Unable	Unable
4 (4)	3,12,18-Yes 11-No	Limited	Weak	3,12,18 Weak 11 Strong	Weak	Weak	Weak	3,12,18 Unable Able 11	Unable
5 (2)	Yes	Limited	Weak	6 Not tested 8 Weak	Weak	Weak	Weak	Unable	Unable
6 (4)	Yes	Limited	Weak	Weak	4,9 Weak 14,15 Not tested	4,9,15 Weak 14-Not tested	9 Weak 4 Strong 14,15 Not tested	Unable	Unable
Totals (18 cases)	94.4% (17/18)	100% (18/18)	100%	88.9% (16/18)	72.2% (13/18)	77.8% (14/18)	61.1% (11/18)	94.4% (17/18)	100% (18/18)
Total tested	94.4%	100%	100%	94.1% (16/17)	100% (13/13)	100% (14/14)	84.6% (11/13)	94.4%	100%

Criteria for data presented in Table 4 and Table 5

Pronation/valgus determined by plumb line, yes is positive, no is negative

Gastroc flexibility limited is ≤ to 12° with knee flexion (normal is 20), ≤ to 5° with knee extended (normal is 10)

Posterior tibialis/FHL/Hip strength: weak is ≤ to 4/5, strong is 4+ or above

Single heel raise: unable to equal uninvolved extremity, able is = to uninvolved

Single hop: unable equal uninvolved extremity, able is = to uninvolved

Calcaneal Eversion Measure standing with goniometer (Table 5)

(Continued on page 246)

Table 5. Follow-up Clinical Findings (3 to 17 months after discharge)*

Subject	Pronation/ Valgus	Calcaneal Eversion	Gastroc Flexibility*	Posterior Tibialis Strength	FHL Strength	Hip Flexion Strength	Abduction Strength	Extension Strength	Single Heel Raise	Single Hop
1	Yes	R 7, L 15	unlimited	weak	weak	strong	weak	strong	unable	unable
2	Yes	R7 L13	limited	weak	weak	strong	strong	strong	unable	unable
3	Yes	R10, L 9	limited	strong	weak	weak	weak	weak	unable	unable
4	Yes	R 7, L 11	unlimited	strong	weak	strong	weak	weak	unable	unable
5	Yes	R 5 L 12	limited	strong	weak	strong	weak	strong	unable	unable
7	Yes	R 6, L10	limited	weak	weak	strong	weak	weak	unable	unable
8	Yes	R 11, L15	unlimited	weak	strong	weak	weak	strong	unable	unable
9	Yes	R 5, L 10	limited	weak	weak	strong	weak	strong	unable	unable
10	Yes	R10, L 9	limited	weak	weak	weak	weak	weak	unable	unable
11	Yes	R 6, L11	limited	strong	strong	strong	strong	strong	unable	unable

*** Subject information from Table 1. All subjects continued dancing at Championship Levels**

Table 6. Percentage of Change to Follow-up**

Clinical Findings	Number (N=11)	Percent of Incidence	Follow up (N=10)	Percent Change To Follow Up
Pronation/Valgus	10	90.9	10	0.0
Gastroc Tightness	11	100.0	7	-36.4
Posterior Tibialis Weak	11	100.0	6	-45.5
FHL Weak	11	100.0	8	-27.3
Weak Hip Abduction	10	90.9	8	-20.0
Weak Hip Extension	7	83.6	4	-42.9
Weak Hip Flexion	9	81.8	3	-66.7
Unable to Single Heel Raise	10	90.9	10	0.0

**** Percent of Incidence to Initial Measures N=11. Follow-up Measurements N=10, Subject 6 lost to follow-up Follow-up Measurements (3 to 17 months after initial). % Change= Final – Initial/Initial x 100**

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Static Muscle Activity and Back Pain in Dentistry

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ABSTRACT

Back, neck, and arm dysfunctions are present in professionals who require forward leaning posture in their jobs. This is most notable in the field of dentistry. Back pain has been prevalent in the dental profession for years. Efforts have been made in an attempt to offer symptom relief; however, minimal gains have been noted. These efforts include, but are not limited to, proper posturing, strengthening exercises, and application of ergonomic devices. Static muscle activity (SMA) is introduced by the author as one potential source that can lead to acute and chronic pain with possible detrimental effects on a person's mental, emotional, and physical health. The theory of SMA and the approaches that can be taken in order to prevent and alleviate back, neck, and arm pain in dental professionals are presented. A more complete understanding of the mechanisms and therapeutic approaches for this condition will be relevant to not only the field of dentistry, but in other forward leaning occupations.

Key Words: myofascial trigger points, prolonged muscle contraction, myalgia, anterior support

INTRODUCTION

Many jobs are completed in a forward bent position for a prolonged period of time. Some jobs include auto mechanic, welder, assembly line worker, and dentistry. Dentistry is one job that has long been described as static in nature as it does not involve repetitive lifting, moving, or heavy resistive activities. Dentists are not asked to complete patient transfers, lift overweight boxes, or perform heavy manual labor. For most of their workday, however, dentists are placed in a relatively sedentary and static body position and asked to complete 8- to 10-hour workdays. Static muscle activity (SMA), required by dentists and other dental professionals (hygienists, assistants, etc), can create a cascade of physical, emotional, mental, and social impairments, leading to acute and chronic pain, increased illness (mental, and or physical), reduced job satisfaction, reduced wages and revenue, and ultimately early retirement.[1]

This article will review the prevalence of neck, arm, and back pain in dentists and their support staff. The recent literature in regard to intervention and prevention of arm, back, and neck pain will be presented. Furthermore, the concept of SMA and its negative effects will be reviewed. Finally, a critique of past and present treatment options, which have been successful, will lead to the proposition of an anterior support device that may assist in reducing the effects of prolonged SMA exposure.

BACKGROUND

Back pain in dentistry has been documented for many years, dating back as far as 1946,[2] when Biller reported that 65% of dentists complained of back pain. Even after the introduction of ergonomic equipment, studies found that back, neck, and arm pain were present in up to 81% of dental professionals (dentists, dental hygienists, dental assistants).[3-5] Additional studies have found that up to 72% of dentists surveyed reported having pain, discomfort, or altered sensation affecting the cervical, thoracic, and lumbar areas of the spine.[6-9] Dentists reported that more than 77% of occupational illnesses were due to postural defects and 66% identified the presence of low back pain.[7,10-12] In a survey conducted by Oberg and Oberg,[13] 81% of hygienists complained of pain in one or both shoulders, followed by neck pain (62%) and back pain (39%). Miller[14] further noted that one in 5 dental hygienists left their jobs due to disability, and the most frequently reported disabilities were related to hand and wrist dysfunctions (carpal tunnel syndrome), as well as back and neck pain.

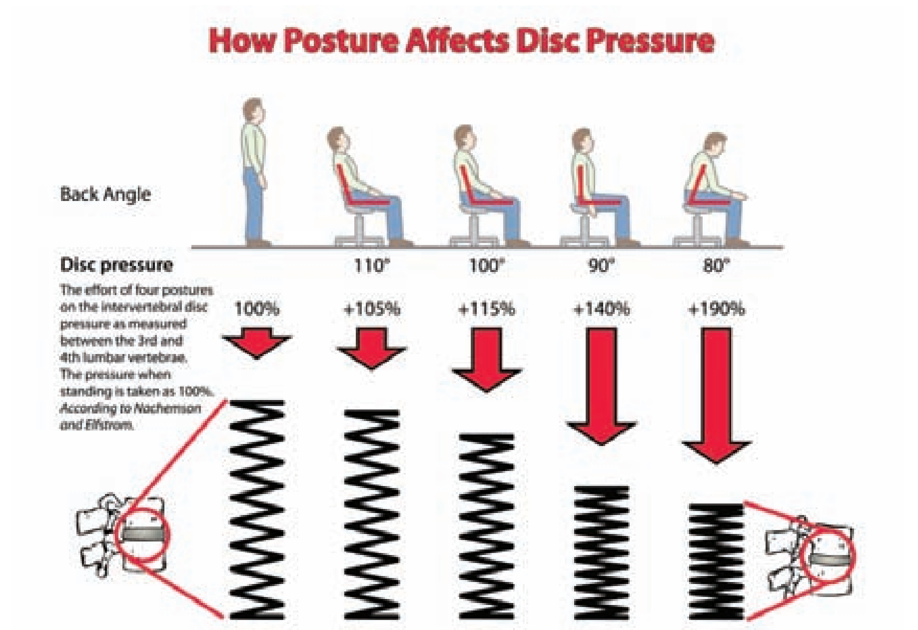
Men and women are equally affected and low back pain is considered "the leading cause of occupational disability in dentistry."[1,15] Those who experienced pain reported that symptoms occurred from 65 to 125 days per year. This equates to the occurrence of pain 18% to 34% of days in a given year. The average dentist lost one work day per year to pain, and 17% reported reducing daily patient load, taking additional breaks, and alternating other practice procedures.[1,16] With regard to disability, Ohlemacher[17] reported that claims for disability benefits have increased by 25% since 2007, and that the most commonly claimed disability was bone and muscle pain, including lower back pain. In 1984, in the United States, the financial impact in the dental profession was estimated as a reduction of $315 per day in billings, totaling more than $41 million of lost revenue,[1,16] and current figures are predicted to be substantially higher. This raises the question, why are back and neck pain so prevalent in the dental profession?

Few studies have attempted to explore objective measurements that can be used to measure the physical processes that cause pain. Numerous studies document subjective pain experiences. However, studies have not discussed in detail the etiology of this pain or specific objective measures to quantify pain. Multiple causes of back and neck pain in dentistry have been proposed, such as postural impairments, disk health, and muscle overuse.[18,21,23] Andersson et al[18] is one of the most often referenced studies of back stress. Measurements of disk pressure and myoelectric activity were recorded across a variety of positions in a small sample of healthy test subjects. The researchers tested supported and unsupported positions in multiple variations. Key findings included:

(1) both myoelectric activity and disk pressure decreased when the back was supported,
(2) optimal results are achieved at a backward inclination of 15° to 20°, and
(3) unsupported sitting increased both disk pressure and myoelectric activity.

The authors also monitored writing versus typing postures. The results showed an overall decrease in disk pressure and muscle activity when the subjects were writing as opposed to typing. In a writing position, an individual is supported at the forearm or wrist while a typist has no upper extremity weight bearing.[18] This finding suggests that anterior support of the trunk can reduce disk pressure and muscle activity similar to posterior support (Figure 1).

Of interest is that both forms of support were placed above the pelvis and not



This illustration depicts how different sitting angles can affect disc pressure.

Figure 1. Disc pressure in sitting. Reprinted with permission from Advance Seating Designs.

from beneath the pelvis. Carter[19] stated that unhealthy posture and back pain in dental treatment delivery will exist until equipment configurations, optical/video systems, seating options, or delivery unit configurations are altered to allow neutral or balanced posture. Most ergonomic injuries in dentistry result from counteracting torque for prolonged periods of time. For every second that a person's head (average male = 14 pounds), is positioned in a 45° forward lean (with a distance of 8 inches from C7 to center of cranium), 6.56 foot pounds of torque must be resisted.[19] Similar to the cervical spine, leaning forward as much as, or even more than, 30° increases the torque demands on the erector muscles to 18.62.[19] This illustrates that an enormous amount of SMA takes place when working in a flexed, unsupported position for an extended period of time.

Static Muscle Activity, Trigger Points, and Myalgia

Static muscle activity has been shown to be a potential factor in many symptoms, most notably pain, especially with prolonged muscle contraction and forward posture activities.[8,23] Lake[8] introduced the concept of SMA as a cause of pain. Because of the sustained muscle contraction, there is a higher potential of causing increased pain due to a loss of alternating muscle contraction and relaxation provided by intermittent muscle activity. Physiologically, when a muscle is maintained in the contracted position for an extended period of time, the surrounding capillaries become compressed, causing blood pressure to rise. This resulted in reduced nutrient and oxygen supply, and the building up of lactic acid, which leads to muscular pain and fatigue. An SMA can only be maintained for a short period of time before pain and tissue injury occurs.[8]

Continued exposure to SMA can progress from acute to chronic conditions, such as trigger points within the supporting musculature. Simons et al[20] defined trigger points as "the presence of exquisite tenderness at a nodule in a palpable taut band of muscle." Furthermore, the activation of a trigger point is usually associated with some degree of mechanical overload, whether it be attributed to acute, sustained, or repetitive loading.[20] For example, individuals who exercised their muscles in a sustained position for a prolonged period of time showed significantly greater back pain than those who exercised their muscles dynamically.[8,23] This is due to the lack of varied muscle activity, which increases circulation and enhances overall tissue.

Research on the occurrence of muscle trigger points continues to expand, and may shed more light on the etiology of pain during positions that include SMA. One explanation of occupational myalgia is the Cinderella Hypothesis. Hägg[21] proposed "muscular force generated at submaximal levels during sustained muscle contractions engaged only a fraction of the motor units available without the normally occurring substitution of motor units during higher force contractions." This results in overloaded motor units, followed by activation of autogenic destructive processes, and muscle pain. In addition, Dommerholt et al[22] included low level muscle contractions as one of several possible causes of trigger points. Studies support that sustained low level muscle contractions for as little as 30 to 60 minutes commonly resulted in the formation of trigger points.[23,24] This is also supported by Chen et al[25] who suggested that low level muscle exertions can lead to sensitization and development of myofascial trigger points. Overall, the awareness that low-level muscle contraction can cause muscle fiber damage and pain has grown throughout the years.

Over the years, research has reinforced that trigger points and SMA can cause motor, sensory, and autonomic impairments,[22] including impaired range of motion, stiffness, and weakness due to muscle inhibition. Sensory effects include local tenderness and referral of pain to a distant site, as well as peripheral and central sensitization.[23] By definition, allodynia and hyperalgesia are a part of central sensitization.[26] Allodynia is pain due to a stimulus that does not normally cause pain, while hyperalgesia is an increased response to a normally painful stimulus. Allodynia and hyperalgesia are very prevalent in dental professions, as well as other professions that maintain SMA.

Unfortunately, dentistry demands sustained and unsupported positions for prolonged periods of time, even if the practitioner maintains the "neutral" or "balanced" position as described by Carter[19] (Figure 2). When placed in the neutral position, if not supported anteriorly or posteriorly, there is a high likelihood of trigger point formation.

Back Pain Prevention and Intervention Strategies

Historically, exercise and postural modification have been the two common solutions proposed in dentistry to try to prevent and treat neck, arm, and back pain. However, research is lacking. Lalumandier et al[11] proposed that "dental professionals can reduce their risk of developing musculoskeletal injuries and pain by using proper body posture and positioning during dental procedures, incorporating regular rest periods, maintaining good general health, and performing exercises for affected body areas." Although the authors suggested an exercise routine, they offered no documentation or follow-up research to support its effectiveness.

Other interventions that have been studied for effectiveness in reducing neck, arm, and back pain in dentists include modalities, more frequent breaks, fewer practice hours, proper posture, and proper stool selections. Shugars et al[6] found that 16% of practicing general dentists reported exercise bringing complete relief, 18% found relief from physical therapy, and only 9% found a change of treatment position to be effective. The highest success rate for obtaining complete relief was the use of a whirlpool (20%). More frequent breaks benefited only 5%, while fewer practice hours benefited 11%. These results indicate, that on the average, no treatment was more than marginally effective, and even the most effective treatments offered relief to only one out of every 5 respondents who tried them.[6] This suggests that once an individual has musculoskeletal pain, the odds are that it will be a long-term problem. Therefore, future efforts should be directed heavily toward prevention.[6]

Over the past 5 to 7 decades, proper posture has been recommended by numerous sources and vigorous research, with Valachi[27] recently advocating for improved posture, proper stool selection, and use of magnification devices to reduce back pain. However, current rates of injury are similar to those reported in earlier studies.[7,8,11] One type of proper seating selection could include a fitness ball. Fitness balls have been used in the work place for treatment and prevention of back pain. This unstable position, however, may cause back and abdominal muscles to be in constant contraction, which according to Rollie Boeding, Director of Wisconsin's State Risk Management, may lead to significant unintended musculoskeletal problems. According to a letter from Rollie Boeding, dated January 26, 2007, to the Administrative Officers Council, extended use of "ball chairs" shorten muscles and place increased compressive force on the spine. He continued to warn that excessive force on the disks of the spine over an extended period of time could cause significant damage to the spine, and permanent back injury. Therefore he strongly recommended fitness balls not be used, secondary to the prolonged muscle activity and instability that is present.

Head forward Pelvis tucked **NO!**	Ear over shoulder Pelvis tipped forward **YES!**	Chest stuck out Pelvis over-tilted **NO!**

Figure 2. This illustration depicts a "neutral" position which is completely vertical with no movement in the sagittal, frontal or transverse plane.

A neutral or balanced seated position and working position has been advocated as being the treatment of choice for the field of dentistry. So what is a "neutral" or "balanced" seated position? A "neutral" position is one that is completely vertical with no movement in the sagittal, frontal, or transverse plane (Figure 2). In dentistry, Wunderlich et al[28] measured the amplitude and duration of angular deviations from 0° during periodontal procedures by using an inclinometer. They found that "up to 85% of the working days were spent in isometric position."[28] Since 90% of the measured deviations were at or less than 10° forward, any movement from the neutral position creates a sustained isometric contraction of the back muscles.[1,28] As a result of these findings, treatments have focused on exercise, stool and equipment modification, and postural correction. However, no significant reduction of symptoms has been reported using these treatment options. This begs the question, if proper posture and exercise are needed in order to significantly reduce neck, arm, and back symptoms in dentistry, then why are these symptoms still so prevalent today?

What Is the Answer?

One area that has been vastly ignored, or lacks significant research, is that of anterior support. If an individual were asked to sit and lean backward approximately 10° to 20° and hold that position for 30 to 45 minutes, it would not take long for discomfort to be reported. Leaning backward causes an isometric contraction of the abdominals to occur, and if held long enough, could cause secondary contractions from adjacent muscles. For example, once the abdominals begin to fatigue, recruitment of other muscles takes place in order to assist in maintaining a seated position. Other muscles may include hip flexors, hamstrings, quads, pectoralis, sternocleidomastoid, etc. Lake[8] described the physiological changes that take place when SMA occurs. If it is understood how maintaining a sustained muscle contraction could lead to pain when leaning backward, then it is easily appreciated how leaning forward without proper support could lead to not only low and mid back pain, but also to neck, arm, and hand symptoms. A vast array of symptoms could be explained due to secondary muscle recruitment that assists the body in fighting gravity, and trying to maintain the "neutral" position (see Figure 2).

By allowing more anterior support, especially in the field of dentistry, SMA could be significantly reduced or eliminated. Anterior support would require less activation of the erector spinae, multifidi, and posterior cervical muscles and allow for relaxed muscle activity while maintaining correct spinal position. In doing so, it could eliminate hypoxias, maximizing adequate blood flow by relaxing muscles, and preventing muscle overuse. Although posterior support is important, it is of little value in dentistry due to the fact that 85% of the working day is spent in a 10° forward isometric position.[29] In addition, it would be very difficult for dentists to perform procedures while leaning back with a 10° to 20° incline, which Andersson et al[18] found to be effective (Figure 3). Postural modification has not been shown to reduce back pain in the field of dentistry,

Figure 3. Optimal seating position. This figure depicts the optimal seated position that offers the least amount of myoelectric activity and disc pressure.

and although certain seat designs can help by facilitating a more proper alignment of the hips and lumbar spine, they are unable to provide effective support.[1,18]

Only a few anterior support devices are available. Books and Klemm[1] designed an anterior support cushion that attaches to a dental treatment chair. They used a frontal support approach with two dentists in Wisconsin, who were being treated for complaints of chronic back pain. Preliminary tests were very promising, with a reduction of pain and an increase in overall function and number of workable hours noted.[1] One of the dentists was treated for chronic back pain and the other had experienced regular back fatigue. The dentist who was being treated for chronic back pain considered retiring within one year due to his chronic pain. After one month of using anterior support, his pain was reduced to an almost non-existent state, which allowed him to continue practicing for an additional 6 years.[1] The second subject, who occasionally sought treatment for back fatigue and soreness, reported a significant reduction in fatigue and muscle effort.[1] Books and Klemm[1] provided other examples of success with an anterior support. A dental practitioner who had been practicing for only 6½ years experienced severe pain in her upper right scapular area. Although she received therapy and strength training for her neck and back pain, she received no benefit. Her symptoms continued to spread to her middle and lower back, as well as her left side after spending more time working. She continued to experience debilitating discomfort, even though a clinical assessment demonstrated that she was using the exact posture advocated by proponents of postural modification.[1] Within 5 months of using anterior support, she reported being painfree and has remained so until the present.

One of the leading examples of anterior support currently offered in dentistry is the AnterioRest (Career Extenders, Omro, WI). Figures 4 through 6 show an anterior support device and how it can be applied to a dental chair to provide torso and mirror arm support for dental professionals. The success of anterior support in dentistry can lead to its application to other professions. Figures 7 and 8 illustrate how an anterior support approach can be used to assist other occupations, such as welders and auto mechanics. AnterioRest is one example of a tool that can be used to provide frontal support in an attempt to minimize muscle overload, and to provide stable and comfortable support of the trunk. By providing anterior support, normal circulation will return, which can resolve the inflammatory reaction and restore tissue health.

One of the disadvantages of providing anterior support may be the cost. The range of cost from ergonomic chairs to braced anterior support could vary by hundreds or even thousands of dollars. This may be cost prohibitive for many dental professionals. Another disadvantage may be that the anterior support device is too space inhibiting, therefore not allowing the dental professional the ability to maneuver around the patient during treatment. Finally, some may require bolting the device to the treatment table, which may not be welcomed by dental professionals. Although disadvantages are present, the advantages of reduced pain, increased function, and increased workable hours may be enough to warrant investigation.

Figure 4. Illustration of how an anterior support device is applied to a dental chair.

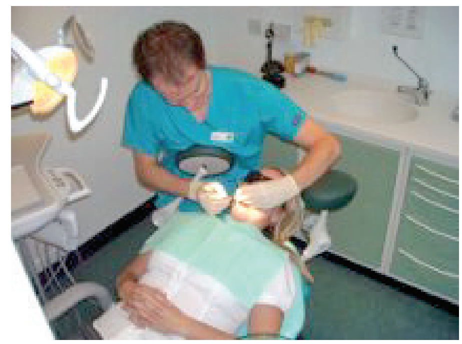


Figure 5. Dentist in supported forward lean using an anterior support device.

Figure 6. Dental hygienist illustrating how to utilize an anterior support device with torso and mirror arm support.

CONCLUSION

Research supports that postural modification and exercise prescription have had no measurable results or benefits in alleviating pain and dysfunction in dentistry. Few effects have been noted with altering work practices, increasing rest breaks, or completing treatment modalities. Although a "neutral" position is not in and of itself a harmful practice, if SMA is maintained over a prolonged time in a repetitive manner, it can lead to unwanted pain, inflammation, and an overall reduction in quality of life. Although initial success and symptom reduction appear positive with the use of anterior support, further studies are needed to evaluate the effectiveness of this approach. Studies may include the EMG of spine and scapula musculature and disk pressure analysis while using anterior support. Pre- and post-testing using qualitative and quantitative outcome measures would provide evidence on the effectiveness of anterior support in the dental profession. Future studies should also explore the relationship between EMG activity of postural muscles, posture, and perceived pain. Providing anterior sup-

Figure 7. Illustration of how an anterior support could be used in the profession of welding.

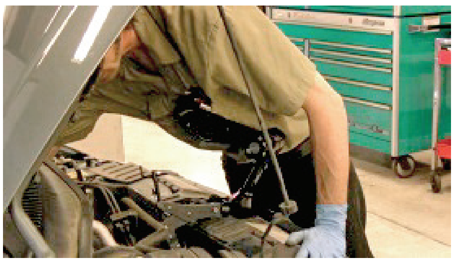


Figure 8. Illustration of how an anterior support could be used in the profession of auto mechanics.

port has shown potential for reversing pain and inflammation in the dental profession, and may assist in improving overall function and quality of life in the field of dentistry.

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Use of a Novel Lumbopelvic Stabilization Program in a Female Runner with Low Back Pain that Satisfies a Clinical Prediction Rule: A Case Study

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ABSTRACT

Background and Purpose: Evidence suggests patients with low back pain who satisfy a clinical prediction rule may benefit from a stabilization program. However, it is unclear if the same benefits would occur if an alternate stabilization program was used in a more active population. Therefore, the purpose of this case study was to describe the effectiveness of a novel lumbar stabilization program for a female runner who met the clinical prediction rule for success with stabilization. **Methods:** Case study involving an 8-week stabilization program. **Findings:** Upon discharge, the patient demonstrated decreased pain, decreased disability, and returned to her prior level of running. **Clinical Relevance:** Patients meeting the clinical prediction rule for success with a stabilization program may benefit from an alternative stabilization program. **Conclusion:** Individualized lumbar stabilization programs that focus on key core musculature may be beneficial to different patient populations. However, continued research is necessary to evaluate prognostic variables for stabilization in a multi-arm trial.

Key Words: low back pain, clinical prediction rule, stabilization, runner

INTRODUCTION

Low back pain (LBP) is a condition that will affect most people at some point in their lives[1-5] and up to 15% of the population will experience recurrent or persistent LBP.[6] Unfortunately, this condition is not isolated to a limited population and has been reported to affect children,[7,8] working adults,[1] and the elderly.[9] For those individuals experiencing acute LBP, recurrence is likely in 50% to 80% within one year.[10,11] Despite the obvious physical implications of LBP, there are also economic factors to consider. Expenses may stem from the direct cost of care, time off of work, and lost productivity.[12,13] It is apparent that LBP is a significant problem in industrialized society. While there are many potential causes of LBP, spinal instability may be one contributing factor.

Lumbar spinal instability has been recognized as a contributing factor to LBP.[14] While multiple definitions for lumbar instability have been published,[14-18] Panjabi[18] defined clinical instability as "a significant decrease in the capacity of the stabilizing system of the spine to maintain the intervertebral neutral zones within the physiological limits so that there is no neurological dysfunction, no major deformity, and no incapacitating pain."[18] Initially it was thought that radiographic techniques were the best way to diagnose instability.[14] However, recent trends have shifted to the use of examination variables in order to assist in directing intervention.[17] Rehabilitation professionals use various examination measures to identify variables related to lumbar instability. Some of these measures include recognizing aberrant movements, the prone instability test, posterior-anterior mobility assessment, pain scales, the Fear-Avoidance Belief Questionnaire, and the modified Oswestry Low Back Pain Disability Questionnaire.[16] While some have reported these assessment tools have questionable diagnostic accuracy, they may provide information when attempting to determine the diagnosis and treatment of LBP, specifically with regard to instability.[16]

There are multiple clinical interventions used for the treatment of lumbar instability. Bracing, therapeutic exercise (ie, abdominal trunk curls, hamstring stretches, pelvic tilt exercises), swimming, walking, education, and spinal fusion have been identified as common treatment options.[19] Recent treatments have been developed for lumbar instability that focus on the training of specific muscle groups, with the goals of promoting stability, decreasing aberrant movements, and relieving pain.[16] It appears that stabilization exercises may be a beneficial approach to enhancing spinal stability.

Spinal stability relies on the action of local and global muscles.[20] While global muscles are responsible for movement in various planes, local muscles attach directly to the vertebrae and provide segmental stability, as well as direct control of lumbar segments.[20] Muscles affecting stability include the multifidi, transverse abdominis, erector spinae, and the internal and external obliques. Over the years, there have been multiple exercise progressions developed to target these muscles in order to improve spinal stabilization;[21-25] however, it is not always clear as to which population is most likely to benefit from a spinal stabilization approach.

Today, clinical prediction rules (CPRs) are being utilized to predict outcomes; place patients into treatment based classifications, and determine the most beneficial interventions.[26,27] In 2005, Hicks et al[16] developed a CPR that identified patients who would benefit from a specific spinal stabilization program (Table 1). Beneciuk et al[28] determined that this CPR rated the highest for overall quality, at 74%, when compared to other CPRs used in physical therapy practice. Secondary to design requirements in CPR methodology, Hicks et al[16] used a specific stabilization program for their investigation. However, to date this CPR has not yet been tested using different stabilization programs. The authors believe an emphasis on functional patterns is an essential component of a

Table 1. Clinical Prediction Rule for Success with Stabilization Treatment Developed by Hicks et al[16]

CRITERIA	DEFINITION OF POSITIVE	CRITERIA MET
Age	Less than 40 years old	No
Average Straight Leg Raise	Greater than 91°	Yes
Aberrant Movement	Observed "catch" when returning to upright posture from a flexed position	Yes
Prone Instability Test	Pain is decreased or absent with posterior to anterior pressure at the affected segment while the subject lifts his or her legs	Yes

well-rounded stabilization program.

The progression described in this case study focuses on functional movement patterns, which have been shown to involve deceleration, stabilization, and acceleration at all joints throughout the kinetic chain and in all planes of motion. This case study examines an alternate stabilization program from that described by Hicks et al.[16] Functional movement patterns have been shown to significantly increase core strength, neuromuscular control, dynamic flexibility, and functional strength, specifically in the athletic population.[29] Exercise programs that integrate functional movement patterns focus on the use of synergistic muscle activation to decrease force in all planes and increase dynamic stabilization.[29] This is particularly important in the athletic population.[29,30] Therefore, the purpose of this case study was to demonstrate the effectiveness of a novel spinal stabilization program for a patient who met the CPR for success with stabilization.

CASE DESCRIPTION AND HISTORY

The patient was a 45-year-old female marketing agent. She reported running between 30 and 40 miles a week at a 9 to 10 minute per mile pace. She presented to physical therapy with left sided LBP. The patient reported that she had recently begun a marathon training program and developed LBP 3 weeks into her preparatory training. She reported discontinuation of her running program for approximately 8 weeks in order to rest. However, the LBP persisted and limited her ability to return to her training program. Her primary care physician referred her to physical therapy for evaluation and treatment. She had not undergone any diagnostic imaging prior to presenting to physical therapy.

INITIAL EXAMINATION

Initial Presentation and Systems Review

The patient was a healthy middle-aged athletic female with a chief complaint of left sided LBP that began approximately 12 weeks ago after changing her training regime and increasing her weekly mileage from approximately 20 miles per week to 40 miles per week. She reported two previous episodes of LBP within the past several years with no specific mechanism of injury, and no remarkable medical history. Upon visual inspection, she had no swelling in the lower back and no postural deviations. She also did not report any neurological symptoms in the involved lower extremity. The patient was taking nonsteroidal anti-inflammatory drugs (NSAIDs) for pain control at the time of initial evaluation.

Functional Status

The patient reported that she had been functioning independently in all activities of daily living (ADL) and in her training program as a runner. She reported that her current symptoms inhibited her daily activities and training program secondary to pain, but she continued to be independent with ADL and work. She noted that her pain increased with activities such as walking, standing, running, and prolonged sitting. However, no specific directional preference existed with regard to her normal activities.

TESTS AND MEASURES

Range of Motion

Active range of motion (AROM) for standing lumbar forward flexion and extension were visually estimated to be 75% and 50%, respectively, of the expected normal motion secondary to pain. Aberrant movements were observed as a "catch" when returning to upright posture from a flexed position. Straight leg raise (SLR) range of motion (ROM) was measured using a standard long arm goniometer. The patient presented with a SLR ROM measurement of 98° on the right and 92 degrees on the left.

Pain

The patient verbally described her pain as "achy." Using a numeric pain rating scale from 0 to 10, 0 being no pain and 10 indicating excruciating pain, the patient rated her pain at initial evaluation as 7/10. Tenderness to palpation was also noted on the left paravertebral muscles at the levels of L2-5.

Muscle Strength

Manual muscle testing revealed that the patient's strength was generally 5/5 for bilateral lower extremities with the exception of hip abductor strength, which was rated as 4+/5 bilaterally. Secondary to her current level of pain, the endurance of her trunk flexor and extensor muscles was not tested.

Special Tests

Prone instability test

The patient demonstrated a positive prone instability test on initial examination. The test was performed by positioning the patient with her trunk supported at the end of a plinth with her feet resting on the ground. A posterior to anterior (PA) force was then applied to a specific segment of the lumbar spine. If pain is noted at the area of pressure, the lumbar extensors are activated to stabilize the spine by lifting the legs slightly. If pain is decreased or absent with PA pressure at the same segment while the subject lifts his or her legs, the test is considered positive (specificity of .58; + likelihood ratio: 1.7; Kappa .87).[16,31]

Aberrant Movements

During ROM testing, aberrant movements were observed as a "catch" when returning to upright posture from a flexed position (specificity of .50; + likelihood ratio: 1.6; Kappa .60).[16,31] Several studies have suggested that the presence of aberrant movements during active trunk ROM is correlated with lumbar segmental instability.[32-34]

Additional Tests

A lumbar quadrant test was performed by placing the standing patient in slight extension and sidebending. While in this position, over pressure was applied to increase the compressive forces through the posterior element of the lumbar segments.[35] Testing revealed increased localized LBP in the right and left posterior quadrant bilaterally. Deep tendon reflexes and sensation were normal and symmetrical when compared bilaterally.

Functional Outcome Measures

At initial examination, the patient scored 18/50 on the Modified Oswestry Low Back Pain Disability Questionnaire. This score is interpreted as 36% and is considered to be representative of moderate disability (20% to 40%).[36] Several studies have shown the Modified Oswestry to be one of the most reliable outcome questionnaires for quantifying LBP.[37-39] It has also been shown to be more responsive than other similar scales and has a high correlation with pain rating scales.[37-39]

EVALUATION

The patient's primary impairment was localized left LBP as a result of altered training patterns in preparation for a marathon. The physical therapy examination revealed an overall decrease in trunk AROM and significant pain. Based on the findings from the initial examination, the patient met the CPR for success with stabilization developed by Hicks et al.[16] The patient satisfied 3 of the 4 variables used to determine success with this CPR (Table 1).[16] After the initial examination, the patient was treated one to two times per week for 8 weeks.

PLAN OF CARE DESIGN

Over a two-month period, the patient was seen in the physical therapy clinic 13 times and was treated with an individualized program including therapeutic exercises with a primary focus on trunk stabilization, home exercise program, and electrical stimulation with cold pack for pain control. Prior to beginning each treatment session, an upper body ergometer was used for 5 minutes as a form of warm-up. The patient began an individualized stabilization program that included abdominal bracing techniques, quad swimmers, pulley row, hip internal/external rotation strength progression; seated straight leg raises, and sit to stands. Over the course of treatment, the program was progressed in both intensity and type. By the final week, the patient was performing all of the initial therapeutic exercises as well as additional exercises including the wheel drill, side planks, hip abduction in a side plank position, half kneeling pulley chops, single leg dead-lifts, star drill, and agility ladder drills (Tables 2-7). All therapeutic exercises were delivered under the supervision of a physical therapist with an appropriate level of cueing to maintain a neutral spine position. The patient performed 2 to 3 sets of exercises with 12 to 15 repetitions each, based on her tolerance.

INTERVENTION

The exercise dosage throughout the 8-week period was 2 to 3 sets of 12 to 15 repetitions based on patient tolerance. The patient was given a continuously revised home exercise program consisting of exercises that did not require equipment.

Week 1

Therapeutic Exercises Included:

Table 2. Week 1 Exercises

EXERCISE	DESCRIPTION
Abdominal Bracing With Marching	Patient position in "hook-lying" and performs an isometric contraction of the abdominals. While holding this position patient performs alternating hip flexion in a "marching" manner.
Keiser Single-Arm (High Position) Pulley Row (Figure 1)	With Keiser arm in highest position and handle attachment used, the patient positioned facing machine in staggered stance. Patient grasps handle with opposite hand of forward foot and performs high row with trunk rotation then returns slowly to starting position. Repeat on opposite side.
Quad Swimmer	Patient positioned in quadruped. While performing an abdominal brace the patient slowly extends the opposite upper and lower extremities then returns to the starting position, and repeats on other side.
Hip Rotation Progression (Figure 2)	Patient positioned in sidelying with both knees flexed and head supported with bottom hand. Start with feet together and separate knees without movement of the pelvis. Next, separate feet while keeping knees together. Then abduct top leg and repeat last move. Finally, abduct and extend top hip and repeat same move. Repeat on opposite side.
Sit to Stand	Patient seated on table with feet flat on ground. Knees and hips are positioned at approximately 90⁰ flexion. Patient stands slowly without use of upper extremities, then lowers self to sitting and repeats.
Seated Straight Leg Raises	Patient seated on edge of table. Patient straightens knee fully then flexes the hip in a straight leg fashion. Patient then lowers extremity and repeats on opposite side.

Week 2

Therapeutic exercises include those from week 1 in addition to the following:

Table 3. Week 2 Additional Exercises

EXERCISE	DESCRIPTION
Wheel Drill (Figure 3)	Patient positioned in double-leg stance and performs front lunge followed by lunge at 45⁰ and finally a side lunge. Repeat on opposite side.

Weeks 3 & 4

Therapeutic exercises include those from previous weeks in addition to the following:

Table 4. Weeks 3 & 4 Additional Exercises

EXERCISE	DESCRIPTION
Side Plank	Patient positioned in sidelying. Weight is supported on lateral side of foot and elbow on table. Patient holds position up to 30 seconds and repeats on opposite side.
Hip Abduction in Side-Plank (Figure 4)	Patient positioned in sidelying, performs a trunk lift with bottom leg flexed at knee. While maintaining side plank position, patient performs hip abduction with top leg. Repeat on opposite side.

Figure 1. Keiser single arm (high position) pulley row: A. start position, B. end position.

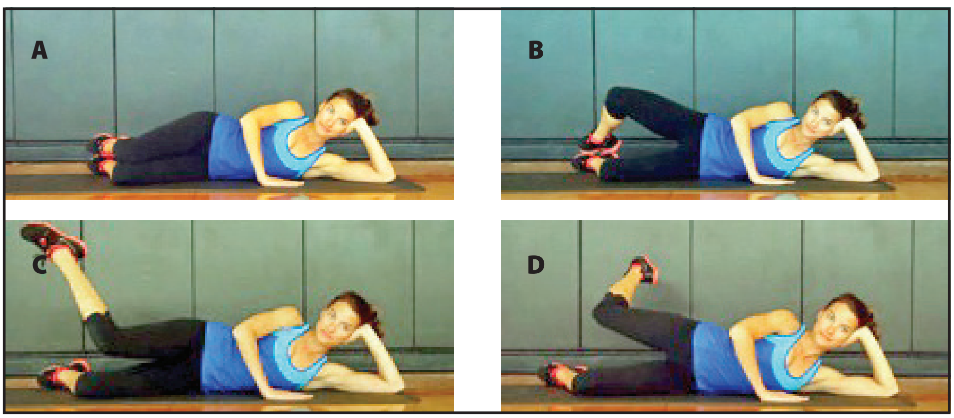

Figure 2. Hip rotation progression: A. both knees flexed, B. feet together, C. maintain knees together, D. abduct and extend top hip.

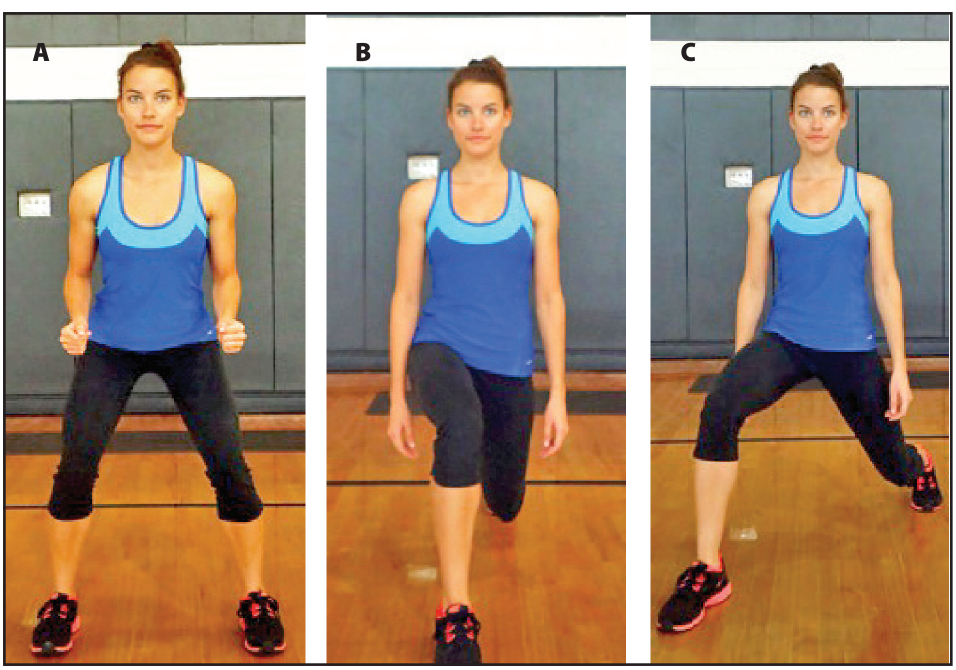

Figure 3. Wheel drill: A. double-leg stance, B. front lunge, C. lunge at 45°.

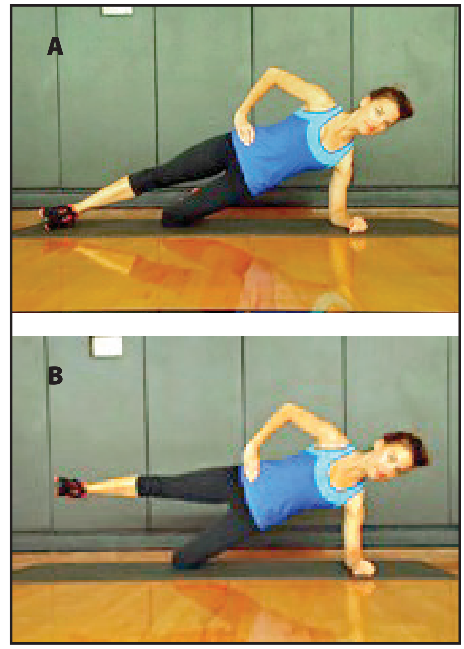

Figure 4. Hip abduction in side plank position: A. start position, B. end position.

Outcomes

Upon completion of 13 visits, the patient had met all initial goals and displayed improvements with objective measures. At discharge, the patient recorded a numeric pain rating of 1/10 and a Modified Oswestry score of 4/50 (8% disability). Active range of motion was now within normal limits in all planes without aberrant movements present. The patient noted minor palpable tenderness over the left paravertebral musculature at levels L2-5; however, it was no longer limiting. She displayed a negative extension and posterior quadrant test bilaterally. The other two variables of the CPR were re-assessed at discharge, the prone instability test and the SLR. The prone instability test was negative and a SLR was possible to 95° bilaterally without pain. The patient showed significant improvements in all areas and reported returning to her original training program of 15 to 20 miles per week at a 9 minute per mile pace, without being limited by pain.

DISCUSSION

Stiell and Wells[40] defined a CPR as, " a decision making tool that is derived from original research and incorporates 3 or more variables from the history, physical examination, or simple tests." Childs and Cleland[26] and Cleland et al[27] have reported that CPRs use variables to predict an outcome or to identify which treatment-based classification will give a patient the best intervention. It has been noted that with the rise of evidence-based practice, CPRs are being used to provide quick estimates of the probability of a given outcome based on research evidence.[41]

In 2005, Hicks et al[16] proposed a CPR which was used to identify individuals with LBP that would benefit from a specific progression of stabilization exercises (see Table 1). A specificity of 0.86 was determined for success with stabilization treatment when 3 or more of the 4 variables were met.[16] However, this CPR investigated only one stabilization program which consisted of specific exercises in supine (bridge and marching with abdominal bracing), standing (row with abdominal bracing), quadruped (arm and leg lifts with abdominal bracing), and side support (isometric holds). The purpose of this case report was to demonstrate whether a patient who met the CPR could benefit from a stabilization exercise design and progression different from that presented by Hicks et al.[16]

The progression presented by Hicks et al[16] focused on the following muscle groups: transverse abdominis, erector spinae, multifidus, quadratus lumborum, and the oblique abdominals. The progression used in this case focused on the same primary muscle groups, however, the exercises that were utilized varied. Multiple studies have supported the importance of strengthening these muscles when treating patients with LBP.[24,25,42-48] Using EMG, Cresswell et al[43] showed that transverse abdominis activation has a direct link to an increase of intra-abdominal pressure which is important for developing trunk stiffness. In a separate EMG study, Hodges et al[44] showed that individuals with LBP had a slower firing rate of the transverse abdominis as opposed to those with no previous history of LBP. Hides et al[42] looked at the multifidus in patients with LBP and found a reduced cross-sectional area on one side of the back and at one vertebral level, suggesting a wasting to protect the tissue in the area. Additionally, researchers showed increases in multifidus muscle thickness and decreases in pain in a specific exercise group versus a general exercise group for patients with chronic LBP, with the specific exercise group showing greater gains in both.[24] Using a unique research design that served to show the connection between the core and hip musculature, Hodges and Richardson[48] analyzed trunk muscle activity during hip movements. The researchers concluded that activation of the transverse and oblique abdominis muscles occurred prior to hip musculature and therefore acted as trunk stabilizers. This implies the importance of a neuromuscular control/coordination program to enhance stability. Similarly, aspects of strength and coordination were important components of the exercise program used in this case study.

The patient in this case study was first evaluated following 8 weeks of self-care, which resulted in no significant changes in symptoms. This suggests the possible influence of the proposed stabilization progression in producing a therapeutic effect, as symptoms in 80% to 90% of LBP cases will resolve spontaneously within 6 weeks.[32,33]

Week 5

Therapeutic exercises include those from previous weeks in addition to the following:

Table 5. Week 5 Additional Exercises

EXERCISE	DESCRIPTION
Hip Flexion/ Abduction on Hip Trotter	Patient stands at hip trotter machine and performs hip flexion and hip abduction with appropriate weight. Repeats on opposite side.
Keiser Half-Kneeling Pulley Chop (Figure 5)	With Keiser arm in highest position and rope attachment used patient positioned parallel to machine in half-kneel. A cushion may be used for comfort. Patient performs cross body chop from high to low then returns slowly to starting position. Repeat on opposite side.

Week 6

Therapeutic exercises include those from previous weeks in addition to the following:

Table 6. Week 6 Additional Exercises

EXERCISE	DESCRIPTION
Single-Leg Deadlift (Figure 6)	Patient positioned in single-leg stance with weight in opposite hand from stance limb and performs a cross-body deadlift. Repeat on opposite side.
TRX Row (Figure 7)	Patient positioned in standing with bilateral upper extremity support with TRX straps. Patient leans back with arms extended, then performs a mid-row bring arms to chest and squeezing shoulder blades together while maintaining abdominal contraction. Patient slowly returns to extended position and repeats.

Week 7 & 8

Therapeutic exercises include those from previous weeks in addition to the following:

Table 7. Weeks 7 & 8 Additional Exercises

EXERCISE	DESCRIPTION
Star Excursion Drill (Figure 8)	Patient positioned in the middle of eight cones extended out at 45º from each other. The patient maintains a single-leg stance in the middle and reaches with opposite leg to touch each cone, returning to center after each. Repeat on opposite side.
Agility Ladder Drill (Figure 9)	1. Begin to the side at the end of the ladder. 2. Step forward at an angle with the left foot into the first hole. 3. Follow with the right foot. 4. Step forward at an angle with the left foot to the left side of the second rung of the ladder. 5. Bring right foot out and maintain single-leg balance. 6. Step with the right foot into the second hole. 7. Step with left foot in the second hole. 8. Step forward at an angle with the right foot to the right side of the third rung of the ladder. 9. Bring right foot out and maintain single-leg balance. 10. Repeat steps #2 through #9.

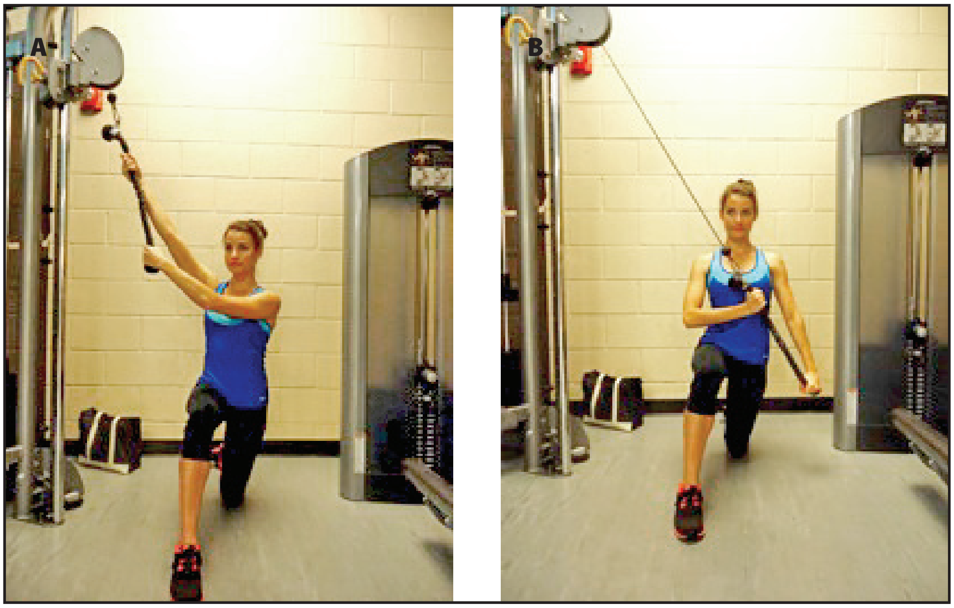

Figure 5. Keiser half kneeling pulley chop: A. start position, B. end position.

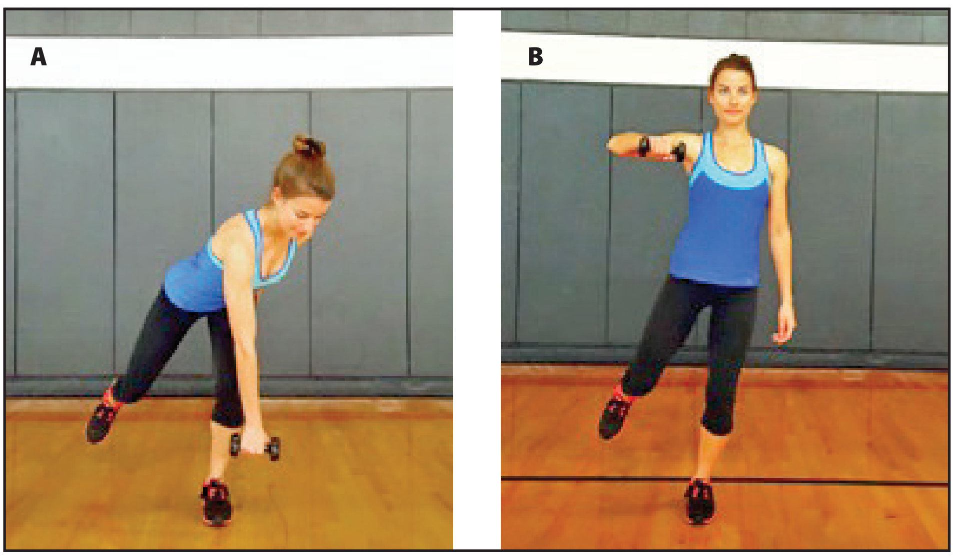

Figure 6. Single leg deadlift: A. start position, B. end position.

Figure 7. TRX row: A. start position, B. end position.

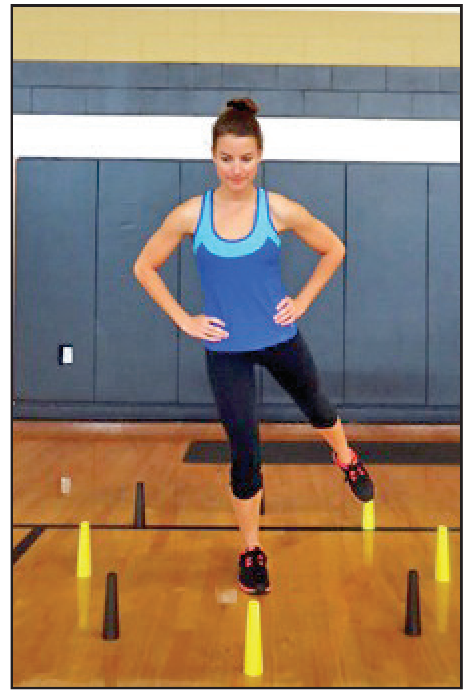

Figure 8. Star excursion drill.

However, in this case study, after 8 weeks of physical therapy treatment, the patient had returned to prior level of function and reported minimal pain.

The patient in the current case study demonstrated a significant decrease in disability on the Modified Oswestry, going from an 18/50 (36% disability) at initial evaluation to 4/50 (8% disability) at discharge. The Modified Oswestry Low Back Pain Disability Questionnaire has been shown to be a valid and reliable outcome questionnaire for quantifying LBP.[37-39] However, this may not hold true for the athletic population. This is supported by the results of a study conducted by Fritz and Clifford.[49] They found that adolescents with LBP who participated in sports experienced less improvement in regards to disability on the Modified Oswestry than nonparticipants following physical therapy intervention. The minimal clinically important difference (MCID) is the amount of change that best distinguishes between patients who have improved and those remaining stable. According to Fritz and Irrgang[50] the Modified Oswestry Low Back Pain Questionnaire has a MCID of 6 points, which is consistent with a 12% overall change. The Minimum Detectable Change (MDC) occurs when the change score indicates that actual change has occurred. Davidson and Keating[38] reported the MDC for the Modified

Oswestry to be 10.5% to 15%. This may suggest the need for further studies to determine a LBP questionnaire that accounts for differences in the athletic population.

Due to the methodological constraints of the study performed by Hicks et al,[16] a cause and effect relationship could not be established. Similarly, a cause and effect relationship could not be determined in this case study. However, Rabin et al[51] conducted a randomized controlled trial that evaluated the CPR and found that a modified version consisting of only aberrant movements and a positive prone instability test seemed to have better predictive validity. Future research should continue to focus on using a randomized controlled trial study design to establish the possible relationships and effects of additional stabilization progressions for individuals who meet the CPR for lumbar stabilization.

CONCLUSION

Currently, there are no studies to support whether or not this CPR can be generalized beyond the initial spinal stabilization program studied by Hicks et al.[16] The purpose of this case study was to highlight a patient who met a proposed CPR and determine if she would benefit from a novel form of stabilization exercises that included functional movement patterns. Clinical prediction rules may hold value in determining the probability of a patient benefiting from a given treatment approach. However, future research should be conducted on larger populations and alternative lumbar stabilization programs should be compared for effectiveness.

Figure 9. Agility ladder drill: A. step 1, B. step 2, C. step 3, D. step 4.

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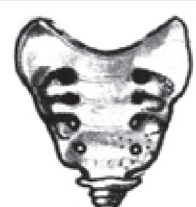
(Continued on page 262)

SCIATICA? LOWER BACK PAIN? HIP PAIN? POOR POSTURE?

IF THE SACRUM IS OUT



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Book Reviews

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

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

Physical Therapy Management of Patients with Spinal Pain: An Evidence-Based Approach, Slack Incorporated, 2014, $94.95
ISBN: 9781556429323, 634 pages, Hard Cover

Authors: Stetts, Deborah M., PT, DPT; Carpenter, J. Gray, PT, DPT, COMT

Description: This book combines clinical practice and clinical research in the treatment of patients with spinal pain. There is a supplemental website with over 375 video demonstrations of the various examination, evaluation, and treatment procedures. **Purpose:** The purpose is to link the latest evidence and clinical practice as they relate to the examination and treatment of patients with spinal pain. The authors meet their goals by thoroughly assessing the current literature in this rapidly changing area. **Audience:** It is intended for entry-level clinicians and advanced physical therapists who treat patients with spinal pain. It also would be a helpful tool for physical therapists who are re-entering the job market or preparing to change the patient population that they will be working with. The authors are both experienced clinicians as well as educators in a doctoral level physical therapy program. **Features:** Initially, the book provides background on evidence-based practice in physical therapy, including two case studies. The next two chapters delve into the general subjective examination and the tests and measures used during a musculoskeletal examination, along with the existing evidence. Tables highlight and summarize key ideas and research. Separate chapters cover low back, thoracic, and neck pain. Various classification systems are presented that can assist therapists in selecting interventions and determine prognosis. A unique appendix contains clinical case studies that apply the concepts in a realistic manner. **Assessment:** This book is well written and thorough. A tremendous amount of information is covered in a clear manner. The authors have written a book with an accompanying video supplement that is the perfect combination of clinical practice and evidence-based practice. The format makes it easy to use the book as a quick reference in the clinical setting.

Jeff Yaver, PT
Kaiser Permanente

Musculoskeletal Interventions: Techniques for Therapeutic Exercise, 3rd Edition, McGraw-Hill Companies, 2014, $85
ISBN: 9780071793698, 1147 pages, Hard Cover

Editors: Hoogenboom, Barbara J., EdD, PT, SCS, ATC; Voight, Michael L., DHSc, PT, OCS, SCS, ATC, CSCS, FAPTA; Prentice, William E., PhD, PT, ATC, FNATA

Description: This book details a variety of interventions for clients with musculoskeletal impairments, with a primary focus on therapeutic exercise. Updated from the 2007 edition, it is consistent with criteria in APTA's Guide to Physical Therapist Practice. **Purpose:** The goal is to provide a "movement-based, functional perspective to the treatment of musculoskeletal movement and dysfunction." The selection and teaching of therapeutic exercise is lacking in many PT curricula, and this book will help to fill the void. **Audience:** The book is suitable for a varied audience. It is intended for use in musculoskeletal interventions courses as a guide for the prescription, selection, teaching, and progression of therapeutic exercises. In addition, the authors assert that it can be used by practitioners seeking new, functional, and innovative progressions for exercises. The three authors are physical therapists and athletic trainers as well as professors in three different PT programs. Features: The first of the book's five sections focuses on foundations of therapeutic exercises, tissue healing, and various impairments related to pain and posture. The second section addresses the specific physiological impairments of muscle performance, aerobic capacity, mobility, and neuromuscular control. Section 3 covers various types of therapeutic exercise interventions, including plyometrics, open and closed chain, PNF, core, aquatics, etc. This section also presents functional screens and interventions, including the FMS and the SFMA. Section 4 divides the body into regions and covers joint and injury-specific exercise interventions. The final section is devoted to special populations, including female athletes, older adults, and children. The book is guide-based, which makes is very user-friendly for PT faculty designing intervention courses. It also presents excellent hypothesis-oriented algorithms for clinicians. These charts are very useful for PT students and can serve as a guide for decision making and development of skills. **Assessment:** This is an excellent addition to any physical therapy curriculum. As a faculty member who teaches musculoskeletal interventions, I think this book will be especially useful in the instruction of this important and often under-taught portion of PT practice. This is the most comprehensive therapeutic exercise book suitable for current PT practice. Readers will appreciate the focus on the disability model and the emphasis on function. This edition incorporates more guide-based terminology and teaches a more functional approach to rehabilitation, an improvement on the previous edition.

Amanda M. Blackmon, PT, DPT, OCS
Mercer University College of Pharmacy and Health Sciences

Orthopedic Manual Therapy: Assessment and Management, Thieme Medical Publishers, Inc., 2014, $79.99
ISBN: 9783131714510, 316 pages, Soft Cover

Author: Schomacher, Jochen, PhD, PT-OMT, DPT, MCMK

Description: This book describes and explains a systematic approach to evaluation and treatment for the locomotor system, covering extremity and spinal joints along with foundational constructs and clinical reasoning principles. It includes detailed photographs and illustrations, documentation templates, and online access to examination and treatment videos. This is the first English-language edition of a German book that is currently in its fifth edition. **Purpose:** The purpose is to detail decision-making processes, drawing on the constructs of pain physiology, biomechanics, neurodynamics, and the biopsychosocial model of disease. The author emphasizes a structured and detailed description of classification systems pertaining to physical examination of the patient and his six categories of treatment. **Audience:** This is an excellent resource for novice physical therapists and for therapists who are in their residency and fellowship training in manual therapy. It is also a good resource for experienced orthopedic manual physical therapists. **Features:** The book is organized in two main sections, on theory and practice. The theory section, devoted to the theoretical and foundational constructs of orthopedic manual therapy, also includes a brief history and definition of orthopedic manual therapy. In this section, the author describes his six categories of treatment and outlines the key aspects of the treatment of joints. The practice section describes in detail the examination and treatment of the extremity and spinal joints. Detailed color photographs, illustrations, and documentation templates are used effectively to describe each technique. Video clips of many of the examination and treatment techniques and PDF files of documentation templates of each body part are available online. An extensive appendix includes the forms used and referred to in the practice section. The practical aspects of the manual therapy approach appear to have a Norwegian influence, likely reflecting the author's training. The manual therapy techniques the book demonstrates are all joint mobilization techniques with an emphasis on compression and distraction and rotational techniques. The book does not describe either soft tissue mobilization or high velocity low amplitude techniques. Readers who are interested in these areas of manual therapy are encouraged to consult other books. Similar to other manual therapy books, this one has a short reference section and the chapter on research is less than one page. **Assessment:** Overall, this is a fine contribution to the orthopedic manual therapy literature. It is an excellent book for therapists in training or residents/fellows developing their orthopedic manual therapy skills. The theoretical constructs it describes, along with the discussions of clinical reasoning and pain sciences, provide a practical framework for experienced practitioners. The strength of the book is its systematic presentation and the use of color photos, illustrations, and videos to demonstrate the practical aspects. The weakness is the lack of referencing of the reliability, validity, specificity, and sensitivity of certain testing procedures and the lack of analysis and discussion of the current research regarding the efficacy of certain techniques.

Timothy John McMahon, MPT
Mercer University College of Pharmacy and Health Sciences

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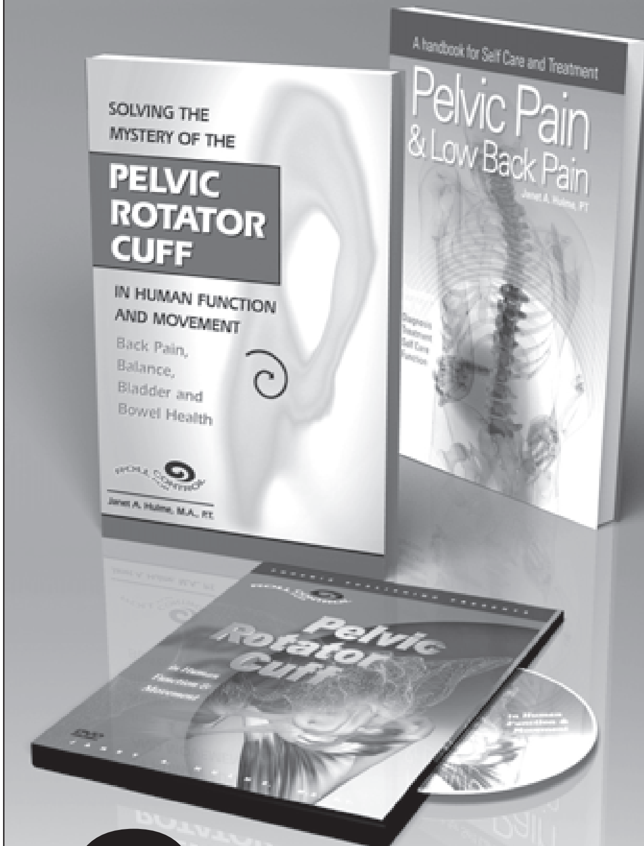

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Course Description

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Topics and Authors

- **The Hip—**Abagale Reddy, PT, DPT; Julie Bage, PT, DPT, OCS; David Levine, PT, PhD, DPT, OCS, CCRP, CertDN
- **The Knee—**Stephanie L. Di Stasi, PT, PhD, OCS; Erin H. Hartigan, PT, DPT, PhD, ATC, OCS; James Selfe, PhD, MA, GD Phys, FCSP; Jim Richards, BEng, MSc, PhD; David Levine, PT, PhD, DPT, OCS, CCRP, CertDN
- **The Foot and Ankle**—Gary B. Wilkerson, EdD, ATC, FNATA; Barry Dale, PT, PhD, DPT, ATC, SCS, OCS, CSCS; Richard G. Alvarez, MD

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

- Understand the normal spatiotemporal characteristics of the hip, knee, and ankle-foot complex during gait.
- Understand the kinetics and kinematics of the joints of the lower extremity during the gait cycle.
- Identify similarities and differences between walking and running for the lower extremity.
- Discuss the manner in which joint coupling transfers torque throughout the kinetic chain.
- Describe the sequential concentric and eccentric muscle actions that occur during the stance phase of locomotion.
- Discuss the stresses imposed by common foot strike running patterns.
- Characterize the gait deviations commonly observed after specific orthopaedic injuries of the lower extremity.
- Describe the evidence for interventions suggested to improve aberrant gait deviations in the lower extremity.
- Understand the clinical implications of persistent aberrant gait patterns.
- Describe therapeutic strategies to manage mechanobiologic processes that can ultimately lead to tendon and articular cartilage degeneration in the foot and ankle.
- Discuss the limitations of the current evidence-based practice to address aberrant gait patterns after orthopaedic injury of the hip, knee, and ankle-foot complex.
- Identify potential future directions for research on treatment of gait deviations that occur following orthopaedic injury.

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Orthopaedic Section, APTA, Inc.

BOARD OF DIRECTORS MEETING MINUTES

July 24-25, 2014

Stephen McDavitt, President, called a regular meeting of the Board of Directors of the Orthopaedic Section, APTA, Inc. to order at 8:00 AM CDT on Thursday, July 24, 2014.

Present:	**Guests via phone:**	**Absent:**
Stephen McDavitt, President	Chris Hughes, ISC Editor	None
Gerard Brennan, Vice President	James Irrgang, National Outcomes Registry Work Group Chair	
Steven Clark, Treasurer		
Tom McPoil, Director		
Pam Duffy, Director		
Duane Scott Davis, Research Chair	**Guest in person:**	
Joe Donnelly, Practice Chair	Duane Deml, Deml Controls	
Tess Vaughn, Education Chair	Sharon Klinski, Managing Editor	
Tara Fredrickson, Executive Associate		
Terri DeFlorian, Executive Director		

The meeting agenda was approved as printed.

The schedule of future Board of Directors conference calls/meetings were presented. Conference calls will be at 8:00 PM EST:

- August 11, 2014 – Board of Directors Conference Call Meeting
- September 8, 2014 – Board of Directors Conference Call Meeting
- October 15-19 - Strategic Planning Meeting/Board Meeting in La Crosse, WI

Wednesday, October 15th
- ✓ Plan to arrive in La Crosse by 4:30 PM
- ✓ Leadership training for all attendees: (start-time TBD) - ??

Thursday, October 16th
- ✓ All day Strategic Planning Meeting for all attendees

Friday, October 17th
- ✓ ½ day Strategic Planning Meeting for all attendees
- ✓ ½ day Board Meeting (Committee Chairs, SIG Leadership, and Coordinators may depart after Noon)

Saturday, October 18th
- ✓ All day Board of Directors Meeting (for 5 elected officers, Education Chair, Practice Chair, and Research Chair)

Sunday, October 19th
- ✓ Travel day for Board of Directors – no meeting scheduled

Attendance at this meeting is **required**! If you are unable to attend, you will need to arrange for another individual to attend in your place, ie, SIG Vice President in place of a SIG President. You may check into, and book your airfare at any time via our travel agency, Travel Leaders: 800-657-4528.

The following motions were presented on the consent calendar –

=MOTION 1= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors approve the Public Relations Policy Cover Page attached.

Fiscal Implication: None

ADOPTED (unanimous)

=MOTION 2= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve the ICF-based Clinical Practice Guidelines Program Policies and Cover Page attached.

Fiscal Implication: None

ADOPTED (unanimous)

=MOTION 3= Gerard Brennan, Vice President, moved that the Orthopaedic Section Board of Directors approve the Osteo-blast Policy Cover Page attached.

Fiscal Implication: None

ADOPTED (unanimous)

The following motions were presented via e-mail –

=MOTION 4= Steven Clark, Treasurer, on behalf of the Finance Committee, moved that the Orthopaedic Section Board of Directors approve transferring $85,000 from the Section checking account to a certificate of deposit which will be laddered according to the other 3 CDs currently in place.

Fiscal Implication: None

ADOPTED (unanimous)

=MOTION 5= Steven Clark, Treasurer, on behalf of the Finance Committee, moved that the Orthopaedic Section Board of Directors approve transferring $100,000 from the Section checking account into the Wells Fargo Advisors Orthopaedic Section Research, Practice, and Education Fund.

Fiscal Implication: None

ADOPTED (unanimous)

=MOTION 6= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors provide funding for one individual to the APTA's CPG workshop to support the development of a Post-concussion Syndrome Management Clinical Practice Guidelines.

Fiscal Implication: Travel to APTA Headquarters and 3 days lodging in Alexandria, VA. ($470)(3 days x $310 = $930). Note that the APTA will be supplying most of the meals for the workshop's participants so the per diem costs will be less than normal. This collaboration was a recent development based upon recent requests from the Sports and Neurology Sections to collaborate so it could not be specifically budgeted in the 2014 budget.

ADOPTED (unanimous)

=MOTION 7= Stephen McDavitt president, moved that the Orthopaedic Section provide funding for one individual to the APTA's CPG workshop to support the development of a Hip Fracture Clinical Practice Guidelines.

Background:

1. The Orthopaedic Section BoD and the Section on Geriatrics BoD both approved the following motion in 2013:
   The Orthopaedic Section and the Section on Geriatrics will collaborate and utilize their combined resources to create clinical practice guidelines on Hip Fractures, 1) coordinated by the Orthopaedic Section ICF-based Clinical Practice Guidelines Coordinator and Advisory Panel, 2) to be published in JOSPT, 3) using the following listing in the title: Clinical Practice Guidelines linked to the International Classification of Functioning, Disability, and Health from the Section on Geriatrics and Orthopaedic Section of the American Physical Therapy Association, 4) utilizing the following copyright and permission statements: ©201_ Orthopaedic Section American Physical Therapy Association (APTA), Inc., and the Section on Geriatrics, APTA, Inc., and the *Journal of Orthopaedic & Sports Physical Therapy* consent to the reproducing and distributing this guideline for educational purposes, and 5) submit to have the guideline on www.guidelines.gov.
   The workgroup leaders/authors from the Orthopaedic Section will be Doug White and Michael Cibulka and the workgroup leaders/authors from the Section on Geriatrics will be Katherine Mangione and David Sinacore, with other authors and reviewers being recruited, as appropriate, to complete this guideline.
2. Doug, Michael, Katherine, and David are willing to contribute as authors of this Guideline but none of them were willing or able to take on the role as Workgroup leader. This was a new development since the passage of the motion last fall. However, fortunately, Christine McDonough has stepped up and accepted the role as workgroup leader for this CPG.
3. Doug, Michael, David, and Christine are able to participate in the APTA's CPG workshop to work on this CPG. The APTA will fund three individuals to participate but is asking the Orthopaedic Section to fund one of the individuals.

Fiscal Implication: Travel to APTA Headquarters and 3 days lodging in Alexandria, VA. ($470)(3 days x $310 = $930). Note that the APTA will be supplying most of the meals for the workshop's participants so the per diem costs will be less than normal. This collaboration was a recent development based upon recent requests from the Academy of Geriatrics to collaborate so it could not be specifically budgeted in the 2014 budget.

ADOPTED (unanimous)

=MOTION 8= Stephen McDavitt, President, moved that the Orthopedic Section Board of Directors approve that an NC-1 form be completed by the President presenting the APTA Nominating Committee with supportive nominations for Sharon

Dunn (candidate for President), Dianne Jewell (candidate for President), Robert Rowe (candidate for Director) and Anthony DiFilippo, PT, DPT, MEd, OCS (candidate for Director).

Fiscal Implication: None

ADOPTED (unanimous)

Steve Clark, Treasurer, reported the Section currently has 73% of its operating expenses in reserves. The Education, Research, and Practice Endowment Fund is now at a level where withdrawals up to 4% per year can be made to support education, research, and practice per Section policy.

Stephen McDavitt, President, updated the Board on the lack of qualified candidates interested in and available to run for Treasurer. Pam Duffy, Director and past Nominating Committee Chair, was appointed as an ad hoc member of the Nominating Committee to lend her expertise and guide them through this process.

=MOTION 9= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve the nomination form developed by the Nominating Committee.

Fiscal Implication: None

Gerard Brennan, Vice President, and James Irrgang, Chair of the National Outcomes Work Group, gave the following National Outcomes Registry update –

1) Quintiles, world leaders in developing registries and APTA consultant, is working with the Section and APTA on the neck pain outcomes agreement.
2) Once the neck pain agreement is finalized similar agreements will be developed for low back pain, knee pain and shoulder pain.
3) The financial arrangement still needs to be addresses with APTA. Once a breakeven point is reached this will generate non-dues revenue for both APTA and the Section. The Finance Committee will look at what a fair return on investment would be at their August meeting.
4) The Board of Directors has already approved creating work groups for low back pain, knee pain and shoulder pain. By the end of 2015, each group will need to create a classification system, case report forms, and an MOOP. Once this is done, they will be ready to give to Quintiles.
5) The plan is for only 4 modules per year (1 per quarter).

Gerard Brennan, Vice President, updated the Board on the status of the Section's technology initiative. Chris Hughes, ISC Editor, was present via phone for this discussion.

Action item: The Board of Directors needs professional consultation to reach a decision related to which of the available platforms (APTA-LMS, Atypon, or both) to use to develop our educational and media IP.

=MOTION 10= Gerard Brennan moves that the Orthopaedic Section Board of Directors hire a consultant

1. To evaluate the two platforms based on the Section's needs and resources to recommend the best strategy of which platform(s) to use to host our educational and media materials.
2. To recommend a media production company or other strategy to begin developing the media rich files we want to host on the platform.

Fiscal implication: Consultant is estimated at $5,000-10,000. Development of enriched files is dependent on how many are developed and to what extent. These decisions can be brought to the Board one package at a time until it makes sense that we have a good estimate of these types of costs. The recommendation is to consider putting $3,000-5,000 in the 2015 budget for development costs.

DEFEATED (unanimous)

=MOTION 11= Tom McPoil, Director, moved that the Orthopaedic Section Board of Directors charge Chris Hughes, ISC Editor, to contact Atypon to assess their ability to provide the required needs and resources for the Section's educational and media materials and provide a report to the Technology Team by September 1, 2014.

Fiscal Implications: None

ADOPTED (unanimous)

=MOTION 12= Tom McPoil, Director, moved to charge Terri DeFlorian, Executive Director, to contact a consultant to assess availability and fees needed to evaluate report information relevant to the needs and resources for the Section's educational and media materials.

Fiscal Implication: None

ADOPTED (unanimous)

Joe Donnelly, Practice Chair, gave the following House of Delegates update –

There were numerous RCs addressed at the 2014 HOD. The following is a brief summary of motions that passed in the HOD.

RC 8-14 TELEHEALTH

Creates an APTA position that telehealth is an appropriate model of service delivery for the profession of physical therapy when provided in a manner consistent with other existing APTA documents.

RC 9-14 PURSUIT OF REGULATORY DEGREE

- APTA shall begin to pursue a uniform change in the regulatory designation of physical therapists in all states to "DPT" by the year 2025.

RC 11-14 MEMBERSHIP VALUE FOR THE PHYSICAL THERAPIST ASSISTANT

- APTA will create a plan for increasing the value of APTA membership for the physical therapist assistant (PTA) and present the plan to the 2015 House of Delegates by December 2014

RC 12-14 PROMOTING EXCELLENCE IN PHYSICAL THERAPIST PROFESSIONAL EDUCATION Creates an APTA position that supports practices that promote excellence in physical therapist education, including recommendations for:

–Academic educators
–Program directors
–Programs
–Clinical sites
–The Commission on Accreditation in Physical Therapy Education (CAPTE)

RC 13-14 BEST PRACTICE FOR PHYSICAL THERAPIST CLINICAL EDUCATION

- APTA will, in collaboration with relevant stakeholders, identify best practice for physical therapist clinical education, from professional level through postgraduate clinical training, with a report to the 2017 House of Delegates.

RC 16-14 TOOLS TO NEGOTIATE PRODUCTIVITY AND PERFORMANCE STANDARDS

- APTA will identify and develop resources that equip PTs and PTAs to negotiate successfully in establishing an agreed upon conceptual framework of productivity and performance to ensure the provision of quality physical therapy care with a report to the 2015 House of Delegates.

RC 17-14 PHYSICAL THERAPISTS QUALIFIED TO DETERMINE MOBILITY STATUS FOR PATIENTS AND CLIENTS APPLYING FOR DISABILITY PLACARDS DISABILITY LICENSE PLATES, OR PARATRANSIT

- Created a position that the APTA supports consumer access to mobility status certification by inclusion of physical therapists as able to make such determinations.

RC 18-14 ENDORSEMENT OF INTERPROFESSIONAL EDUCATION COLLABORATIVE CORE COMPETENCIES

- Creates a position that the APTA endorses the 4 Interprofessional Education Collaborative Core Competency domains and their respective general competency statement. APTA and its members will endeavor to integrate these IPEC core competencies into practice and education initiatives, where feasible.

RC 19-14 ELECTION TO HONORARY MEMBERSHIP IN THE AMERICAN PHYSICAL THERAPY ASSOCIATION

- That Michael J. Axe, MD, be elected as an Honorary Member of the American Physical Therapy Association.

RC 21-14 EFFORTS TO CURB FRAUD, WASTE, AND ABUSE

- Referred for development of a position on the role and responsibility of PTs and PTAs in reducing fraud, waste, and abuse.

RC 22-14 RESCIND PHYSICAL THERAPIST RESPONSIBILITY AND ACCOUNTABILITY FOR DELIVERY OF CARE

- Physical Therapist Responsibility and Accountability for the Delivery of Care (HOD P06-12-06-08), is rescinded.

RC 23-14 USE OF APTA POSITIONS, STANDARDS, GUIDELINES, POLICIES, AND PROCEDURES

- Creates an APTA position that, "the American Physical Therapy Association (APTA) positions, standards, guidelines, policies, and procedures are intended to communicate best practice for physical therapist practice. Acknowledging that these APTA documents are and should be used to inform state practice acts, these documents are not intended to limit the development of innovative approaches to physical therapist practice in the evolving health care system."

Stephen McDavitt, President, stated that a report on governance review would be provided in writing by October 1, 2014.

Joe Donnelly, Practice Chair, reported that he would have a full summary of the 2014 House of Delegates proceedings at the October Board of Directors Meeting.

Stephen McDavitt, President, reported that the PTA survey has been completed and is with APTA for formatting.

Stephen McDavitt, President, shared with the Board his dialogue with a JOSPT advertiser on how the Section can help better serve his mission.

Stephen McDavitt, President, informed the Board that NC-1 forms were submitted to APTA indicating our support for the following individuals –

- Vice President: Sharon Dunn and Dianne Jewell
- Director: Robert Rowe

The Board agreed to also submit NC-1 forms for the Lisa Saladin and Pauline Flesch for Vice President and Susan Appling for Director.

Terri DeFlorian, Executive Director, gave the following Section office update –

- The office is still investigating the use of SharePoint as a communication tool for committees and SIGs. Stephen McDavitt asked Terri to contact the Illinois Chapter Executive Director about another program they are using that they are very happy with.
- Sharon Klinski, Managing Editor, updated the Board on the Independent Study Course sales and courses currently in production as well as how the temporary agency employee is working out.

  =MOTION 13= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve offering the Physical Therapy Evaluation of the Animal Rehabilitation Patient ISC as a 2-monograph course instead of a 3-monograph course, providing the material is still current. The price would remain the same as for a 3-monograph course with each registrant being provided a $30 coupon to be used toward a current ISC of his or her choice.

  Fiscal Implication: $30 per registrant

  ADOPTED (unanimous)

  The Board agreed to have Steve McDavitt contact Kirk Peck, ARSIG President, to inform him of the Board's decision.
- The Section audit is underway and will be completed the beginning of August.
- The Finance Committee will meet August 21-22, 2014 at the Section office in La Crosse, WI.

=MOTION 14= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors adjourn the meeting and go into Executive Session.

Fiscal Implication: None

ADOPTED (unanimous)

=MOTION 15= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors invite Tess Vaughn, Education Chair; Joe Donnelly, Practice Chair; Scott Davis, Research Chair; and Terri DeFlorian, Executive Director to sit in on the Executive Session.

Fiscal Implication: None

ADOPTED (unanimous)

Duane Deml, Deml Controls, was invited to present on the current status of the Section office building's HVAC system as well as give several options for replacing the system.

=MOTION 16= Steve Clark, Treasurer, moved that the Orthopaedic Section Board of Directors accept option #3 in the attached proposal and build the new addition to the building on the north end where the storage shed is. Moving forward is contingent on bids not exceeding the total cost given for option #3.

Fiscal Implication: $367,000

ADOPTED (unanimous)

=MOTION 17= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors adjourn the meeting and go into Executive Session.

Fiscal Implication: None

ADOPTED (unanimous)

Stephen McDavitt, President/ICF Board Liaison, on behalf of Joe Godges, ICF-based Clinical Practice Guidelines Coordinator, addressed the **ACL Prevention Guideline (NEW).**

Action Item: Joe Godges, ICF-based Clinical Practice Guidelines Coordinator, requested the Board to review and act on a motion to initiate the development of this guideline. Following review and action by the Orthopaedic Section Board of Directors, the motion can be forwarded for review and action by the Sports Section Board of Directors. The ICF-based CPG Coordinator requests that the Orthopaedic Section review and act on the following motion, which was prepared by David Logerstedt, Lynn Snyder-Mackler, and Joe Godges.

=MOTION 17= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve the Orthopaedic Section and the Sports Section collaborate and utilize their combined resources to create clinical practice guidelines on Primary Anterior Cruciate Ligament Injury Prevention under the following conditions:

1) The guidelines will be coordinated by the Orthopaedic Section ICF-based Clinical Practice Guidelines Coordinator and Advisory Panel,
2) Will be published in JOSPT,
3) Will be entitled: ***Clinical Practice Guidelines linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section and the Sports Section of the American Physical Therapy Association,***
4) Will utilize the following copyright and permission statements: ©201_ Orthopaedic Section American Physical Therapy Association (APTA), Inc., the Sports Section, APTA, Inc., and the *Journal of Orthopaedic & Sports Physical Therapy* consent to the reproducing and distributing this guideline for educational purposes, and
5) Will be submitted as a guideline on www.guidelines.gov.

Fiscal implication: Fiscal Implication (in proposed 2015 budget line 4180):

$4,000 for "Author Fees" to develop this guideline - one time budget action. Following this, a $2,000 per year fee will be required for the CPG revision process that will likely begin in 2018.

ADOPTED (unanimous)

Stephen McDavitt, President, discussed using the above format for submitting motions for the Board to address. He will put something together and distribute to the Board.

=MOTION 18= Tom McPoil, Director/PASIG Liaison, moved that the Orthopaedic Section Board of Directors approve the development of a 2-year, $15,000 grant for performing arts research using existing PASIG encumbered funds.

Fiscal Implication: $15,000 ($7,500 per year for 2 years)

From Research Committee Grant Criteria –

3. Foot and Ankle clinically-based grant
   a. Eligibility
      i. Orthopaedic Section member, and a minimum of a BS in PT degree
   b. The Foot and Ankle Special Interest Group is sponsoring a clinically based grant.
   c. This grant can be up to 2 years in length.
   d. Funding amount: $15,000 total, $7,500 per year for 2 years.

ADOPTED (unanimous)

Stephen McDavitt, President, informed the Board that the ARSIG President would like to send a letter in support of a PT obtaining a visa. The Board agreed he cannot state he supports her application as the ARSIG President of the Orthopaedic Section since this would be an endorsement by the Section. He can only support her as an individual. Steve McDavitt will communicate this to the ARSIG President.

Tess Vaughn, Education Chair, and Tara Fredrickson, Executive Associate, reported on the following –

- Annual Orthopaedic Section Meeting
  - ✓ 2014 Annual Orthopaedic Section Meeting Income/Expense Comparison
  - ✓ Subcommittee of content experts to determine topics and speakers will include the President and Vice President from the initial planning stage. The Education Chair, President, and Vice President will meet in October to begin planning for the 2016 meeting.
  - ✓ 2015 Annual Meeting conference calls with speakers will include the President and Vice President.
  - ✓ 2016 Annual Meeting locations were suggested and will be further investigated.
  - ✓ Annual Meetings beyond 2016 will be discussed at the 2015 July Board meeting.

Duane Scott Davis, Research Chair, presented the following –

=MOTION 19= Scott Davis, Research Chair, moved that the Orthopaedic Section Board of Directors approve Dan White, Research Vice Chair, to attend the 2015 July Board meeting in La Crosse as part of his potential transition to the Research Chair position in 2016.

Fiscal Implication: ($600)(2 days x $255 = $510) = $1,110

ADOPTED (unanimous)

=MOTION 20= Scott Davis, Research Chair, moved that the Orthopaedic Section Board of Directors approve a $5,000 increase in the Unrestricted Research Grant from $25,000 to $30,000 starting in 2016.

Fiscal Implication: An additional $5,000 to the Research Grant Budget on a yearly basis. Therefore, this motion represents an increase in the yearly research grant budget from the current $70,000 to $75,000 beginning in 2016.

ADOPTED (unanimous)

=MOTION 21= Scott Davis, Research Chair, moved that the Orthopaedic Section Board of Directors approve a CRN-Project Grant [$30,000 over 2 years] that would leverage the research network developed by the current CRN funded project.

Fiscal Implication: $30,000 starting in 2016 dispersed in approximately equal amounts ($15,000) in 2016 and 2017.

POSTPONED INDEFINITELY (unanimous)

The Board agreed to postpone discussion on this motion until the CSM 2015 Board meeting to allow the Board more time for review of documents and to attend the CRN meeting at CSM if they wish.

Joe Donnelly, Practice Chair, presented the following –

=MOTION 22= Joe Donnelly, Practice Chair, moved that the Section create a site license for the Orthopaedic Residency/Fellowship Curriculum with the following recommendations:

a. The program must have an electronic classroom capability for posting the Monographs that is protected to the Residents/fellows, Faculty and Clinical Faculty. Email is not an acceptable method.
b. The following pricing structure be considered:
   i. 1-4 Residents/fellows $350.00 per resident/faculty* (12% discount)
   ii. 5-9 Residents/fellows $300.00 per resident/faculty* (25% discount)
   iii. > 10 Residents/fellows $250.00 per resident/faculty* (37% discount)
c. The site license does not include the tests that correspond with the monographs. If a program would like the tests, there is an additional $100.00 fee. The tests are mailed to the Program Director and the Program Director is responsible for distribution of the tests to his residents/fellows. Scantrons will be provided by the Section. The Program Director will return the Scantrons to the Section office for grading. The Section office will provide the program director with the resident's tests results.
d. For each site license that is sold, the Section office will follow up with each program prior to renewal regarding the copyright rules and the option for renewal.

Fiscal Implication: None
ADOPTED (unanimous)

=MOTION 23= Joe Donnelly, Practice Chair, moved that the Orthopaedic Section Board of Directors approve that tests for the residency/fellowship program only be sent to the program directors from this point forward. They are no longer to be sent to the residents.
Fiscal Implication: None
ADOPTED (unanimous)

- Most of the ISCs that make up the Residency Curriculum are outdated and should be revised to include current evidence-based information. These include Pharmacology, Diagnostic Imaging in Physical Therapy, Postoperative Management of Orthopaedic Surgeries, and Clinical Applications of Orthopaedic Basic Science. Chris Hughes, ISC Editor, will be notified of this recommendation.

=MOTION 24= Joe Donnelly, Practice Chair, moved that the Orthopaedic Section Board of Directors provide support for Kathy Cieslak, Practice Vice Chair, to attend the strategic planning and Board meeting in its entirety October 15-19, 2014, in La Crosse, WI, to include travel and lodging.
Fiscal Implication: $600 travel; 4 days x $250 = $1,000. Total = $1,600
ADOPTED (unanimous)

- Teaching OMT content to non-PTs was discussed. The Board advised Joe to discuss with specific companies/organizations over the phone and send them a copy of our policies.

Stephen McDavitt, President, lead a discussion on SIG EIG policies as they pertain to submitting programming for CSM. The Board agreed to continue this discussion at the October Fall Board meeting.

=MOTION 25= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors appoint Jason Oliver as the PTA EIG Chair.
Fiscal Implication: None
ADOPTED (unanimous)
Stephen McDavitt, President, opened up a discussion on the dry needling and residency petitions to become a SIG that were received.

=MOTION 26= Pam Duffy, Director, moved that the Orthopaedic Section Board of Directors reject the request from the dry needling group to become a SIG for the reason that this practice area is related to pain and should fall under the PMSIG.
Fiscal Implication: None
ADOPTED (unanimous)

=MOTION 27= Pam Duffy, Director, moved to approve the Orthopaedic Residency EIG pending confirmation of member signatures.
Fiscal Implication: None
ADOPTED (unanimous)

Stephen McDavitt, President, opened up a discussion on term limits for contracted and appointed positions. Discussions will continue between the President, Vice President, and Executive Director and will be brought back to a future Board meeting.

Gerard Brennan, Vice President, updated the Board on the outcomes course planned for 2016. Since it may take longer to get this course completed, it was recommended that one or more courses in the residency curriculum be updated for 2016 and postpone the outcomes course until 2017.

Review and approval of the web site policy cover page will be addressed at the August Board of Directors meeting.

The Board addressed how to support staff in order to keep things updated in a timely manner and keep up with backlog work. Adding additional staff was mentioned. Discussion on this will continue on the weekly calls with the President, Vice President, and Executive Director.

Stephen McDavitt, President, lead a discussion the Section's purchase of a table at the APTA Celebration of Diversity annual dinner. It was suggested we check into donating to their scholarship fund instead. A motion will be brought before the Board once more information has been gathered.

=MOTION 28= Stephen McDavitt, President, moved that the Orthopaedic Section Board of Directors approve donating $250 to the APTA Leadership Appreciation Party held at the NEXT meeting on an annual basis beginning in 2015.
Fiscal Implication: Annual budgeted item beginning in 2015
ADOPTED (unanimous)

The Board of Directors discussed the critical issues facing orthopaedic physical therapy. A list of the most important issues was generated and will be sent to Ginger Nichols who will be facilitating the October strategic planning meeting. The Board also discussed leadership training topics submitted from committee chairs and SIG presidents. These ideas will also be forwarded to Ginger Nichols in preparation for our October leadership training session.

The Board decided to hold the 2015 Fall Board meeting in Salt Lake City, UT. Gerard Brennan will gather information on a few locations and bring back to the Board.

Pam Duffy, Director/Liaison report –

- The Public Relations Committee members have selected committees and SIGs each will be a liaison to for information that can be sent to the membership via Facebook and Twitter.
- The OHSIG is waiting to hear from APTA on whether or not they will be accepted to receive a $10,000 grant to pursue clinical practice guidelines.
- A contract is being drafted by the office for a consultant to work on the FASIG entry-level curriculum for PT education.

Tom McPoil, Director/Liaison report –

- The Membership Committees mentee/mentor program for this year will be completed in 2 months. The program has been very successful for both mentors as well as mentees.
- A conference call is scheduled with the PMSIG prior to the October Board meeting.
- The PASIG is considering offering a research grant using their encumbered funds. The grant would follow the criteria used for the Foot and Ankle grant stated in the Research Grant policy.

Gerard Brennan, Vice President/Liaison report –

- ISIG Research Committee held a conference call to explore planning for submission to the National Institutes of Health for funding for a R13 conference on developing imaging in physical therapist practice, education, and research.
- The ISIG formed a steering committee and writing has begun on an Imaging Education Manual.

Terri DeFlorian, Executive Director, reported on the progress made with electronically archiving hard copy information. The idea of creating a library to honor past officers on their accomplishments while in office as well as to orient new Board members was presented.

Steve Clark, Treasurer, reported that the 2015 draft budget is looking good at this point. The Finance Committee will meet at the end of August to review the budget and make recommendations to the Board.

ADJOURNMENT 1:51 PM CDT
Submitted by Terri DeFlorian, Executive Director

OCCUPATIONAL HEALTH

SPECIAL INTEREST GROUP

The Occupational Health Special Interest Group serves as a resource for members involved in the field of Occupational Health Physical Therapy. The Special Interest Group is happy to direct you to their first podcast produced by Chris Studebaker. Check out the Orthopaedic Section website under the OHSIG to access the podcast and previous literature reviews and articles of interest for members.

http://www.orthopt.org/content/special_interest_groups/occupational_health/news_from_your_ohptsig

Meetings and conferences of interest for members may be listed on the SIG website by sending information to lpettet@aol.com.

Work Disability Prevention and Integration Conference

The Work Disability Prevention and Integration (WDPI) Biennial Conference serves as an international forum for research and knowledge implementation related to work disability prevention and integration, across all causes of work incapacity. Participants include the leading international experts in the field--scientists, health care and rehabilitation providers, employers, human resource managers, public and private insurers, lawyers, and policymakers. The first WDPI meeting was held in 2010 in Angers (France) and the second in 2012 in Groningen (The Netherlands), attracting 200 delegates from 25 countries all over the world. This year we received the largest response ever to the call for abstracts, leading to an excellent conference featuring the most recent scientific developments in the WDP field. The course was held September 29-October 1, 2014 at the Hyatt Regency Hotel in Toronto (http://www.wdpi2014.iwh.on.ca/).

Is Perching the New Paradigm? The Assessment of a New Working Posture

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INTRODUCTION

The dramatic rise in occupational sitting time over the past 30 years has been well documented[1,2] and largely attributed to a shift away from agricultural jobs toward sedentary jobs created by the technology boom. Since the adoption of the computer, sitting time at work has increased from an average of 3.4 hours to 6.3 hours per day.[2] Concurrent increases in non-active leisure activities, including driving, has compounded the lack of occupational physical activity. For example, sedentary leisure time spent viewing television (TV) alone has doubled since 1950.[1] This is an alarming number given that Owen et al[3] found a dose-response relationship between TV viewing time and metabolic risk factors such as waist circumference, systolic blood pressure, and blood bio markers.[3] Overall, because of occupational and leisure activities, individuals spend an average of 7.7 hours per day being sedentary.[4] The associations between this increasingly sedentary lifestyle and increased rates of metabolic (eg, obesity, type 2 diabetes, altered lipoprotein lipase), cardiovascular (eg, hypertension, venous thromboembolism), and musculoskeletal disorders (eg, low back and neck pain) is recognized as a public health issue;[5] thus, solutions that reduce prolonged sitting are warranted. The purpose of this paper is to describe the various health risks associated with prolonged sitting, review workplace solutions, and highlight a new type of sitting worthy of investigation.

METABOLIC AND CARDIOVASCULAR IMPLICATIONS FROM PROLONGED SITTING

Reduced Exercise Activity Thermogenesis

Obesity has risen due to highly accessible, inexpensive energy-dense foods and concurrent physical inactivity.[6] Two-thirds of the population are overweight (BMI >25 kg/m^2) and one-third are obese (BMI>30 kg/m^2), problems attributed to a persistent positive energy balance as small as 100 kcal/day.[6] Since obese individuals tend to be sedentary at least 2.5 hours per day more than fit individuals,[7] there has been a focus on increasing workers' moderate to vigorous physical activity outside of the workplace. Employers have funded workplace wellness programs to guide physically inactive individuals toward a more active lifestyle. However, a study by Green et al8 assessed the success of a 10-week workplace program and found that despite a short-term increase, physical activity levels were not different at the 6-month follow-up due to busy work and home schedules. This was validated by Kruger and colleagues,[9] who stated the most common reasons for not participating in worksite wellness programs were lack of time before, during, and after work.

Despite the challenges in promoting more moderate to vigorous activity in workers, it is possible that prolonged, low nonexercise activities such as sitting cannot actually be offset by moderate to vigorous exercise. A study by Katzmarzyk et al[10] showed a dose response relationship between increased sitting time and risk of disease. Sedentary individuals had up to a 50% increase in mortality due to cardiovascular or metabolic diseases, even among those individuals who engaged in physical activity. This supports the notion that excessive sedentary time, regardless of physical activity, is an independent risk factor for diseases such as obesity and cardiovascular disease.

Reduced Nonexercise Activity Thermogenesis

According to work by Hamilton et al,[11] one adverse consequence of physical inactivity could be the down regulation of the enzyme lipoprotein lipase (LPL) found to be associated with obesity, type 2 diabetes, and coronary heart disease.[11,12] Given that the typical engagement in moderate to vigorous physical activity may not be enough to prevent the down regulation of LPL, researchers have studied other methods of thermogenesis. The thermogenesis required to complete everyday tasks, with the exception of intentional exercise, has been termed as nonexercise activity thermogenesis (NEAT), and has been linked with increased energy expenditure.[13-15] Since more than 58 million people in the United States alone have sedentary jobs, finding ways to increase NEAT at work may be advantageous for preventing the incidence and severity of cardiovascular and metabolic diseases.[16]

Levine et al[13] assessed the thermogenic potential of low activity fidgeting while sitting and standing to see if it could contribute to an individual's energy balance. According to the authors, when compared with the metabolic rate in a supine position (5.4 ± 1.5 kJ/min), fidgeting increased energy expenditure by over 50% versus only a 4% increase while sitting. The difference was even larger when comparing standing while fidgeting (94%) to standing alone (13%). For comparison, walking at 1.6 km/h increased the metabolic rate by 154% over resting in supine. Therefore, implementing the World Health Organization's recommendation to increase energy expenditure by 834 kJ/d (200 kcal/d) would be equivalent to an obese individual partaking in a fidgeting-like activity of 2.5 h/d or strolling-equivalent activity of 1 h/d.[13] Therefore, increasing energy expenditure (NEAT) through everyday tasks, such as occupational sitting, may be an important way to maintain good health by potentially reducing down regulation of LPL associated metabolic and cardiovascular diseases.[11]

MUSCULOSKELETAL IMPLICATIONS FROM PROLONGED SITTING

Prolonged static sitting also has important implications for the musculoskeletal system. Sixty percent of office workers complain of physical discomfort[17] with sitting thought to be a main cause.[18] The L4/L5 compressive forces are higher by an average of 500N in sitting versus standing with a similar pattern seen for anterior/posterior (A/P) shear forces.[19] Although both positions are well below the NIOSH tissue tolerance limit of 3400N and 500N,[19,20] prolonged low level static compressive and shear forces can be problematic.[19] Additionally, the human body requires movement to nourish its structures such as the intervertebral discs[19-22] and to facilitate varying muscle pattern recruitment to prevent physiological muscle fatigue.[21-23] Static muscle contractions result in fatigue and discomfort with only 2% of one's maximum voluntary contraction (MVC) being the recommended limit for sustained static muscle tension (contraction).[21] Sustained tension in the neck and shoulder muscles during computer use has been identified as a predisposing factor for the development of pain.[22] Therefore, much attention has been focused on the development of work positions that reduce prolonged static postures thus minimizing physiologic and biomechanical loads.

Andersson and colleagues[24] measured muscle activity of the trunk in upright and reclined postures while sitting and standing. Electromyography results found that lumbar supports and increased seat angle (reclined position) reduced trunk muscle activation levels. A study by Schuldt et al[25] showed that a whole spine flexed posture versus an upright one (neutral spine) increased static neck and shoulder muscle activity, both of which were reduced if the sitting position was reclined. Although a reclined position and/or chair support can reduce static muscle loads, people tend to lean forward and not use back or forearm supports when engaging in computer work,[26] lessening the benefits of both.

In addition to position, one's posture while sitting or standing may be an important determinant of physiological and biomechanical load. O'Sullivan[27] compared sway stance and slump sitting to upright (neutral spine) standing and sitting. Both sway and slump postures are strategies adopted to reduce workload on the muscles, thereby reducing energy consumption. These postures also increase stress on passive (noncontractile) structures, such as lumbar discs and ligaments, that may lead to low back musculoskeletal disorders (MSDs) or exacerbate MSD symptoms.[27,28] Similar to slump sitting, a decrease in activation of the superficial lumbar multifidus, internal oblique, and thoracic erector spinae muscles was observed during sway standing. Therefore, adopting more upright work postures may use a more active system thereby reducing stress on passive structures that can become painful when under prolonged static loads.[29]

In summary, prolonged static sitting has implications for the metabolic, cardiovascular, and musculoskeletal systems and it has contributed to diseases of epidemic proportions for the enormous number of people with sedentary jobs. Increasing moderate to vigorous physical activity is not always practical nor independently effective in reducing risk of health disorders from being sedentary. NEAT appears to be effective at increasing metabolic activity and maintaining LPL function. Changing positions and postures positively impacts the musculoskeletal system by reducing static muscle tension and increasing nourishment of noncontractile structures. Therefore, increasing NEAT through changes in position and posture may positively impact the health of those with sedentary jobs who are at increased risk for metabolic, cardiovascular, and musculoskeletal disorders.

SOLUTIONS

Exercise While at Work

Attempts to reduce prolonged static seating have been made by incorporating stair steppers and treadmills into computer work stations. McAlpine and colleagues[30] developed an officeplace stepping device for use under a desk and showed an average increase in energy expenditure above sitting by 289 or 102 kcal/hour in fit individuals and 335 or 199 kcal/hour in obese individuals. Treadmill workstations were devised to allow users to alternate between sitting and walking while working. However, like stair stepping, walking while working required workers to perform two or more tasks at a time. In addition to gross motor tasks, workers simultaneously engaged in cognitive tasks, such as calculating, comprehending, interpreting, and problem solving. However, concern about dual task cost, or dividing attentional resources between treadmill walking and office work that may compromise work performance, limited its use. Recently, the research on NEAT, which showed that low-level activities might help control weight[13] revived the idea of using treadmill workstations. In fact, a study by Levine and Miller[15] found that if obese individuals walked 2 to 4 hours per workday at about 1 mph, daily energy expenditure would increase by about 500 kcal per day causing a weight loss of 20 to 30 kg/year.[15]

To determine the potential impact of treadmill workstations on productivity and the quality of work, a study by John et al[31] assessed cognition and processing tasks (reading and math) as well as computer interface tasks (mousing and typing). They found a slight decrease in typing and mousing efficiency and a 6% to 11% decrease in fine motor skills and math problem solving. There were no significant differences in selective attention and processing speed or reading comprehension. Ohlinger and colleagues[32] found that the addition of low-intensity walking did not negatively affect performance on cognitive tasks, but it did affect motor tasks.[32] Straker et al[14] also found that typing performance was diminished during walking, with a 6% decrease in actual typing speed and a 17% decrease in perceived typing speed when compared to sitting.[14] Mouse performance also diminished while walking, with a 14% in actual and a 26% decrease in perceived mouse pointing speed compared to sitting. Of concern was the 106% increase in mouse pointing error rate while walking. Cycling while working was also assessed and had just slightly lower decrements for typing and mousing performance than walking.[14] Although activities like stair stepping, cycling, and even walking are highly practiced, they are not automatic and can have a negative impact on other concurrently performed tasks.

Although the suggested benefits of walking just 25% of the workday may be worth offsetting the increased health risks associated with prolonged static sitting,[13] there are some practical aspects to consider. First, for individuals who are completing tasks that require high cognition, they may not be able to afford reductions in productivity.[33] The high cost and space requirements of treadmill or bicycle workstations make them less appealing for employers to implement. Finally, the adoption of such workstations by workers remains questionable.

The Sit-Stand Paradigm

The sit-stand paradigm emerged to provide relief and rest for both passive and active structures in the spine while eliminating the challenges associated with exercise workstations. The criticality of pauses and variation of loads for physiological and biomechanical benefits have been well documented.[19,34,35] The goal of the sit-stand paradigm is to optimize the benefits of both sitting and standing into one workday. Sitting provides stability and support to the torso, allowing for proximal fixation with distal precision of upper extremity movements. Standing allows for variation in loads compared to sitting, with more demand on the circulatory system and muscles of the lower extremities and back. Standing for part of the workday has been recommended to reduce work-related MSD complaints associated with sitting.[36] Husemann et al[36] increased standing time of participants by 25% throughout the workday using sit-stand desks and found that there were fewer physical complaints.[36] And, although it has been suggested that standing could enhance cognitive performance, stimulation, and awareness through activation of the cardiovascular system,[37-39] there actually has been some evidence of dual-task cost detriments with standing.[36,40] Most importantly, there was poor compliance with the sit-stand workstation paradigm.[41] So although sit-stand workstations offer variability in work positions and postures, they are typically underused due to perceived difficulty and/or forgetting to make such adjustments in work posture settings.

Dynamic Sitting through Perching-The New Paradigm?

Perching is a term that describes a position that is between sitting and standing (Figure 1). A new workstation design offers a seat pan that tilts freely on a support stick that has a mobile attachment to a base on the floor. The user leans or perches on the seat, assuming an open hip angle of approximately 135°, which facilitates an anterior tilt of the pelvis. The perching posture prevents slump sitting and sway stances facilitating a more vertical spine (see Figure 1). The user must balance on the seat pan putting pressure through both feet, increasing the dynamic nature of the position. The desk is large and has a flare similar to a cutout to allow for upper extremity support (Figure 2) that may help reduce negative impact of sustained neck and shoulder tension.[42] It can be positioned flat or tilted toward the user. The dynamic aspect of perching may help increase NEAT by providing some benefit to offset the cardiovascular and metabolic risks that sedentary workers face.

However, there could be drawbacks to perching as well. It is possible that the position shifts loads from passive structures in the spine to those in the knees and/or hips since there is sustained pressure through the lower extremities. The lack of back support may cause excessive prolonged strain on active structures in the spine and the small seat pan could place excessive contact stress on the thighs, thus restricting blood flow in the legs. Finally, it is unknown whether an increase in NEAT is substantial enough to help increase the overall energy balance, and whether it can do so without negatively affecting cognition and performance. More research is needed to assess whether perching itself can be the new paradigm, or whether it can be part of a new sit-perch-stand paradigm that will positively impact the "sitting disease" epidemic.

QUANTITATIVE ASSESSMENT OF PERCHING

The first step in the assessment of perching is to refine measurements that can detect differences between the biomechanical and physiological requirements of perching versus sitting and standing. Further research should explore:

- Oxygen consumption and heart rate across various postures.
- Venous blood flow and pressure mapping to assess the contact pressure at the seat pan.
- Motion analysis studies to assess:
  - o the amplitude and distribution of center of mass movement;
  - o joint angles of the knee, hip, shoulder, and spine; and
  - o shear and compressive forces on the spine and lower extremity joints.
- EMG to assess activity of the:
  - o lumbopelvic stabilizer muscles
  - o lower extremity muscles (quadriceps, hamstrings and gastroc/soleus), and
  - o neck/shoulder muscles (upper trapezius and deltoid).

If findings are favorable to perching, additional research will be needed to assess positive or negative implications on cognition and computer use. Further research will also be needed to assess comfort, preference, and usability. Finally, it is highly possible that perching itself is not the new paradigm, yet part of a paradigm that specifies a recommended amount of sitting, perching, and standing throughout the day that may vary by task and user goals.

Figure 1. An example of a perching versus sitting using the Focal Locus Seat (www.focaluprightfurniture.com/).

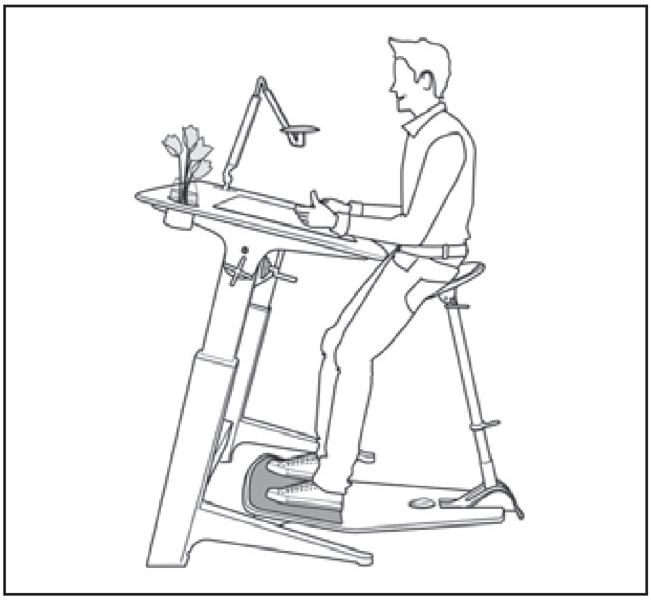

Figure 2. An example of forearm support while perching using the Locus Workstation.

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24.1 The Injured Worker

COURSE DESCRIPTION

This course covers topics related to the roles, responsibilities, and opportunities for the physical therapist in providing services to industry. Wellness, injury prevention, post-employment screening, functional capacity evaluation, and legal considerations are covered by experienced authors working in industry. Current information is also related to how the Affordable Care Act impacts physical therapy services.

TOPICS AND AUTHORS

- **Work Injury Prevention & Management: Determining Physical Job Demands**—Deidre Daley, PT, DPT, MSHPE; Jill Galper, PT, MEd; Margot Miller, PT
- **Work Injury Prevention & Management: Legal and Regulatory Considerations**—Gwen Simons, Esq, PT, OCS, FAAOMPT
- **Work Injury Prevention and Management: The Role of the Physical Therapist in Injury Reduction/Prevention and Workforce Wellness**—Michael T. Eisenhart, PT
- **Work Injury Prevention and Management: Injury Management Considering Employment Goals**—Cory Blickenstaff, PT, MS, OCS
- **Work Injury Prevention & Management: Ergonomics**—Lauren Hebert, PT, DPT, OCS
- **Work Injury Prevention, Management Coordination, and Communication**—Douglas P. Flint, DPT, OCS

CONTINUING EDUCATION CREDIT

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

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

Additional Questions:
Call toll free 800/444-3982
or visit our Web site at:
www.orthopt.org/content/c/24_1_the_injured_worker

PERFORMING ARTS

SPECIAL INTEREST GROUP

President's Letter

Annette Karim, PT, DPT, OCS, FAAOMPT

CSM 2015 will be in Indianapolis, IN, at the Indiana Convention Center. The dates are February 4-7, 2015. Registration opens in September, though housing is now available at http://www.apta.org/csm/.

The Orthopaedic Section Performing Arts SIG is pleased to announce this year's PASIG speaker is Dr Clare Frank, PT, DPT, OCS, FAAOMPT. Dr Frank serves as a clinical instructor for both Spine & Sports Rehabilitation Fellowship programs at Kaiser Permanente in Los Angeles. She served on the injury prevention and rehab team for the National Training Center in Beijing, China (2010-2013) and the medical team for the 2009 World Figure Skating Championships held in Los Angeles. Dr Frank is a certified instructor for Janda's Approach to Musculoskeletal Pain Syndromes, and Kolar's Approach to Dynamic Neuromuscular Stabilization.

Dr Frank will speak about and demonstrate *Dynamic Neuromuscular Stabilization in Spinal Rehabilitation and Performance.*

It should be an informative session. Dr Frank will teach clinically applicable uses of Dynamic Neuromuscular Stabilization in evaluating and treating performing artists.

The PASIG website has been updated. Please check out our page:

http://www.orthopt.org/content/special_interest_groups/performing_arts

If you are thinking about a clinical question related to performing artists, you might find your answer in our monthly citation blasts, which is emailed to all PASIG members. Past monthly citation blasts are available, with citations and the EndNote file, listed on the website: http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes

If you are interested in writing a citation blast, contact Brooke Winder: BrookeRwinder@gmail.com.

PASIG membership is free! All Orthopaedic Section members are welcome:

http://www.orthopt.org/sig_pa_join.php.

Current PASIG members: update your profile here:

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

CSM 2015 students who have been accepted to present a performing arts poster or platform, we have $400.00 of scholarship money you can apply for:

https://www.orthopt.org/uploads/content_files/PASIG/PASIG_scholarship_criteria_flier_2015.pdf

Applications must be in by November 15, 2014. Award notification will be sent in December 2014 for CSM 2015.

Performing Arts resources are available to members for free:

https://www.orthopt.org/content/special_interest_groups/performing_arts/pasig_resources

The resource pages full of art-specific information on

- Artist-specific Terminology (ie, jumps, spins, instruments, turns)
- Genre Specific Terminology and Definitions
- Common Injuries
- Artist-specific Evaluations
- Performing Arts-specific Interventions
- Patterns of Regional Interdependence Association with Specific Injuries/Pathologies
- Return to Arts Progressions

Other helpful information on the PASIG website: Performing arts affiliations and PT schools, PASIG officer listing, performing arts practice analysis, bulletin board.

Tweet Tweet! We have a Twitter page!

PT4Performers

Post your articles, info on your site, let's get connected!

Check out the Orthopaedic Section Facebook page, where you can find and post PASIG info: https://www.facebook.com/pages/APTA-Orthopaedic-Section/121020534595362

The PASIG will have one Nominating Committee position available in 2015. Please contact Rosie Canizares if you are interested: rcc4@duke.edu

If you are currently using a dancer screening exam, please contact Sarah Wenger, as she is seeking input on a single screen that she will make available to our members. She can be reached at sbw28@drexel.edu.

If you are seeking a more formal method of continuing education on performing artists, there is an independent study course available through the Orthopaedic Section website:

https://www.orthopt.org/content/c/20_3_physical_therapy_for_the_performing_artist

Lastly, the quarterly publication of *Orthopaedic Physical Therapy Practice* magazine is a useful source of clinically relevant information. Case reports, case series, clinical pearls, and original research are presented in this publication. Please consider submitting your case report or research on performing artists to the PASIG newsletter. If you are interested in submitting your writing, please contact Annette Karim: neoluvsonlyme@aol.com.

FOOT & ANKLE

SPECIAL INTEREST GROUP

President's Corner

Entry-level Curriculum Update

Clarke Brown, PT, DPT, OCS, ATC

Since 2011, the FASIG membership has directed most of their energy and resources toward developing a mechanism to assist in the delivery of foot and ankle education. Comprised of both academic and clinical specialists, the FASIG was motivated by maximizing the information available to orthopaedic instructors, and in turn, maximize the exposure to foot and ankle content to entry-level students. The FASIG members decided to create a document that referenced all available research regarding foot/ankle examination and treatment, combined with curriculum-based laboratory examples and case studies that would act as a useful tool for orthopaedic instructors. Thus, FASIG membership began creating "Foot and Ankle Curriculum Guidelines for Entry-level Physical Therapists."

Currently, this guide is in the proofreading stage, ensuring a format consistent with existing curriculum yet up-to-date regarding research. Several hours of preparation by many foot and ankle specialists has resulted in an impressive document. Input is always welcome and we encourage all Section members to access the current version of the guidelines through the Orthopaedic Section website at www.orthopt.org.

Ankle Sprains: Brace vs Rehab vs Research Design

Physical therapists often encounter patients who suffer an ankle sprain. While ankle sprain is the most common sports-related injury with a high rate of recurrence, it is also a common nonsports-related injury. Therefore, physical therapists in many different domains and work settings should be aware of recent literature that might direct their care. At the same time, physical therapists should be cognizant of how the research itself is generated, presented, and rationalized. This column looks at research related to this patient-care decision: Should a patient with recurrent ankle sprain undergo a course of physical therapy, wear an external brace, or both?

Clinical Practice Guidelines (Ours)

When it comes to ankle sprains, the physical therapist should turn to our very own Clinical Practice Guidelines.[1] This comprehensive document reviews over 250 scholarly articles related to the examination and treatment of ankle sprains and provides a framework for gauging effectiveness of interventions. *Quality* of research is considered and is weighted heavily when clinical decisions are at stake. This document should be the primary resource for physical therapists who desire "best practice" decision-making. I have a copy on my desk; it is worn and torn.

Regarding rehabilitation and bracing for patients with ankle sprain, the Guidelines are clear.

1. Balance and proprioceptive training, dynamic warm-up, general stretching, and therapeutic exercises are strongly recommended. Restoration of range of motion, especially dorsiflexion, is important.
2. The frequency of ankle sprain is reduced by the use of external supports, bracing, or taping and these treatments are most effective in those with previous ankle sprain injuries.

Clinical Practice Guidelines (Theirs)

Kerkhoffs et al[2] recently published a consensus statement regarding diagnosis, treatment, and prevention of ankle sprains and produced an evidenced-based guideline. Like its American counterpart, the recommendations were based on systematic reviews and the conclusions were clear.

1. It is recommended to train balance and coordination, especially among athletes, starting within 12 months after the occurrence of the injury.
2. Exercise therapy should be included as much as possible into regular training activities or at home to prevent recurrences or both.
3. It is recommended to use a brace or a tape to prevent a relapse.

A Recent Study

A recent article related to the use of bracing and exercise for recurrent ankle sprains caught my eye, with regard to the methodology and implications. Janssen et al[3] investigated the role of external ankle braces on the long-term prevention of recurrent ankle sprains, further comparing braces against "neuromuscular training" and the use of both exercise and bracing.

Janssen et al[3] assessed 384 athletes, aged 18 to 70, who had sustained a lateral ankle sprain, and randomly assigned them to 3 groups; a training group, a brace group, and exercise with bracing (combi group). The training group received an 8-week home-based neuromuscular training program, the brace group received a semirigid ankle brace to be worn during all sports activities for 12 months, and the combi group received both. The main outcome measure was self-reported recurrence of ankle sprain. At one-year follow-up, 69 participants (20%) reported a recurrent ankle sprain: 29 (27%) in the training group, 17 (15%) in the brace group, and 23 (19%) in the combi group. Janssen et al[3] concluded that bracing was superior to neuromuscular training in reducing the incidence, but not the severity, of self-reported recurrent ankle sprains.

A closer look at the implementation of the neuromuscular training intervention suggests significant differences from exercise regimens which might include emphasis on ROM, proper warm-up, and stretching. In the Janssen et al study,[3] participants in the neuromuscular training group received an 8-week home-based program, involving 3 training sessions a week, with a maximum duration of 30 min/session. An instructional DVD was provided. A balance board was provided. Compliance was self-reported. Subjects undergoing both bracing and the exercise program ceased exercise at 8 weeks. Patients in this study were recruited online and their home-based exercises were not supervised.

Implications

The findings of Janssen et al[3] seemed to contradict a consensus statement published one year earlier by denouncing rehabilitation as second to the brace as a single preventive measure against recurrent ankle sprain. This contradiction can be understood by poor research methodology—even the group that underwent exercise and bracing had more recurrent sprains than the brace group! The trickle-down of this invalid finding is potentially damaging to patients and physical therapists:

1. Does the physician who reviews abstracts of articles in the literature interpret this study as suggesting that physical therapy and rehabilitation is no longer needed and a brace is just as effective? (Ironically, an orthopedic surgeon referred me to this article.)
2. Does the physical therapist who reviews articles in the literature notice that of the 24 cited articles in the Janssen et al[1] study, none were authored by physical therapists?

I, for one, will forward this review to local physicians, because it is imperative that the role of rehabilitation not be misrepresented by the article title, Bracing is superior to neuromuscular training for the prevention of self-reported recurrent ankle sprains: a 3-arm randomized controlled trial. For the practicing orthopaedic physical therapist, neuromuscular training is much more than a balance disk.

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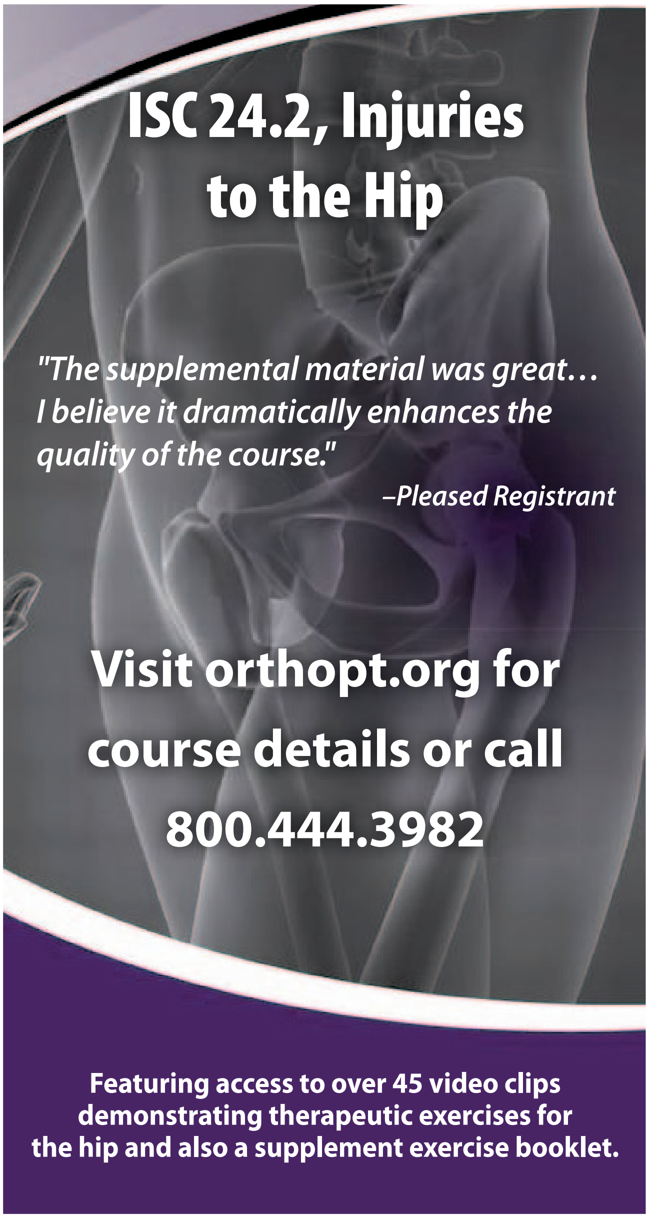

IMAGING

SPECIAL INTEREST GROUP

Survey of Physical Therapy Education

An article describing imaging education in physical therapy programs was recently published in the *Journal of Orthopaedic and Sports Physical Therapy*. Please see the citation below and check it out! The information adds to our knowledge and should be helpful to physical therapist education programs in curriculum design.

Diagnostic and Procedural Imaging Curricula in Physical Therapist Professional Degree Programs

Boissonnault WG, White DM, Carney S, Malin B, Smith W. *J Orthop Sports Phys Ther.* 2014;44(8):579-B12.

Research Committee

The Research Committee is continuing to explore applying for an NIH R13 Conference proposal.

The Research Committee is comprised of:

George J Beneck, PhD, PT, OCS, KEMG, Chair
Daryl Lawson, PT, MPT, DSc
Murray E. Maitland PhD PT
Robert C. Manske, PT, DPT, SCS, MEd, ATC, CSCS
Chuck Thigpen, PhD, PT, ATC
Teonette Velasco, PT, DPT, OCS

Imaging Education Manual

Work is progressing on the writing of our Imaging Education Manual. Our timeline is to circulate a draft to identified stakeholders in October. Then we will refine the manual based on feedback. At CSM, we will present the manual at our Business Meeting. This portion of the meeting is open to all APTA members. Anyone with an interest in imaging in physical therapist education is encouraged to attend and provide input to the manual. We hope to publish the manual in a yet to be determined manner in the spring of 2015.

The Steering Committee writing the manual is comprised of:

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

CSM Programing

Please plan to attend *Imaging and Low Back Pain: What's Useful, What's Not?* with George Beneck, PT, PhD, OCS. Combined Sections Meeting in Indianapolis, Thursday, February 5, 2015, 11:00 AM – 1:00 PM

Call for Imaging Submissions

The Imaging SIG is soliciting submissions for publication in this space. Types of submissions can include:

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

Submissions should be sent to: John C. Gray, DPT, OCS, FAAOMPT, Publications Editor at jcgray@san.rr.com

Join Us on Twitter

Douglas M. White @Douglas_M_White
Deydre Teyhen @dteyhen
James Elliot @elliottjim

Imaging Pearl

Radiographic Evidence of Adjacent Segment Degeneration Following Anterior Cervical Disk Fusion

John C Gray, DPT, OCS, FAAOMPT

Anterior cervical disk fusion (ACDF) is not an uncommon surgery in the United States for persons suffering from a variety of cervical spine conditions such as severe degenerative disk disease, unstable listhesis, and cervical myelopathy. For those contemplating surgery, one of the many questions to ask the surgeon is, "What are the risks of developing adjacent segment degeneration (ASD) and what can been done to minimize that risk?" This simple case presentation provides an example of ASD following ACDF. A lateral plain radiograph (Figure 1) was taken shortly after a 3-level ACDF. Fifteen months later, a follow-up radiograph was taken (Figure 2). In this follow-up image, ASD is clearly seen at the segment immediately below the fusion (Figure 2). In this case, significant progression of degenerative disk disease occurred in just 15 months at the segment immediately adjacent to an ACDF.

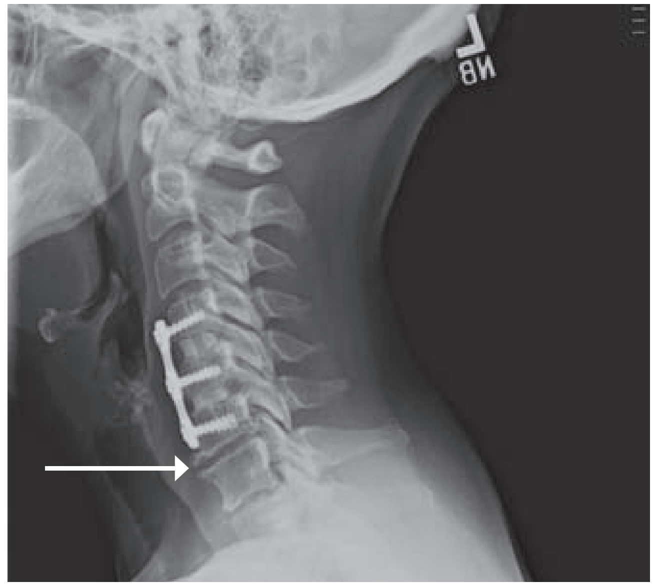

Figure 1. Lateral plain radiograph of the cervical spine in patient with C4-6 ACDF. The white arrow points to moderate degenerative disk disease at C6-7.

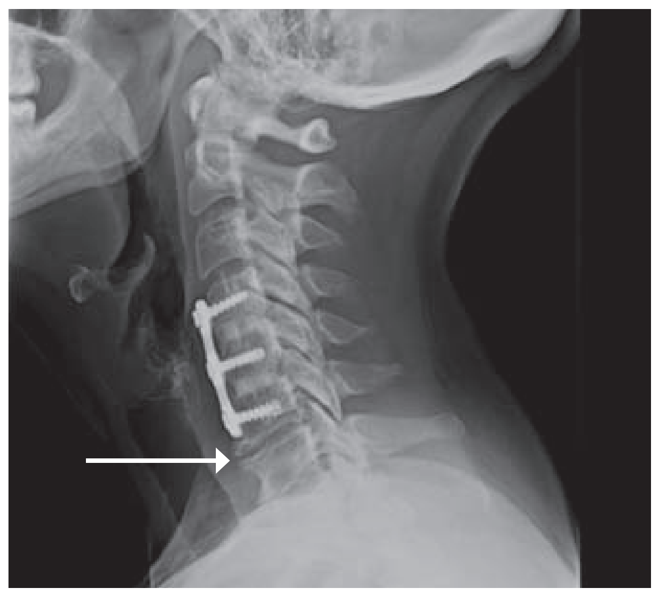

Figure 2. Same view of the patient 15 months later. The white arrow points to C6-7 which now demonstrates a worsening of the degenerative disk disease.

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LEADERSHIP

Douglas M. White, DPT, OCS, RMSK – President / dr.white@miltonortho.com
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Richard Souza, PT, PhD, ATC, CSCS
John C. Gray, DPT, OCS, FAAOMPT – Publications Editor
Gerard Brennan, PT, PhD - Ortho Section Board Liaison

ANIMAL REHABILITATION

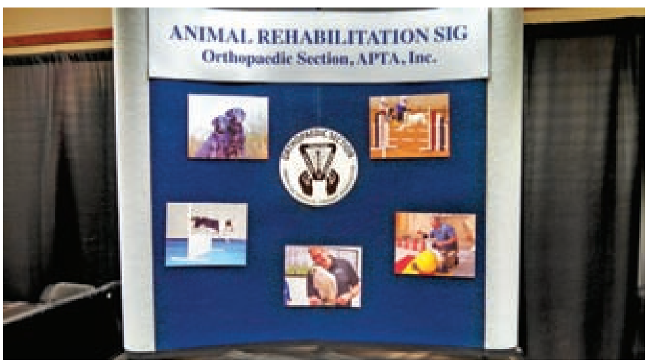
SPECIAL INTEREST GROUP

President's Message

Kirk Peck, PT, PhD, CSCS, CCRT

8th International Symposium on Veterinary Rehab/ Physical Therapy and Sports Medicine:

The International Symposium was held in Corvallis, OR, August 3-8, 2014. Attendance exceeded 250 veterinarians, veterinary technicians, and physical therapists representing over 21 countries including Canada, Sweden, Africa, the UK, Slovenia, Germany, and the Netherlands to name a few. Presentations were well attended and covered a variety of topics, including regenerative medicine, rehabbing the sporting canine, multiple topics on equine rehab, and updates on laser therapy.



The ARSIG had its own booth at the symposium thanks to the generosity and support of the Orthopaedic Section. The booth generated a lot of interest by attendees and even resulted in a little income through sales of the canine anatomy clipboards that some of you may have seen at past events. The clipboards are still available through the Orthopaedic Section, and we hope to have a few for sale at the 2015 Combined Sections Meeting in Indianapolis as well. If interested, please visit the Orthopaedic Section booth in the exhibit hall at CSM.

Recent State Legislative Action:

On August 20, the Governor of Nebraska signed into law proposed Rules and Regulations from the Board of Veterinary Medicine and Surgery allowing PTs to practice on animals through referral by a veterinarian. Essentially that means a veterinarian must first provide medical clearance, but may then refer to a physical therapist, or other qualified health care provider for animal rehab. The Nebraska law is a bit unusual in that "other" qualified providers were also at the table during years of language negotiations. Those professions included chiropractic, occupational therapy, massage therapy, and acupuncturists.

For the past 8 years, I have spent countless hours attending Veterinary Board of Medicine meetings to negotiate acceptable language with a common goal in mind; to lay a path for future therapists wishing to legally treat animals in Nebraska. The key element of the NE law is that healthcare providers who acquire a license to treat animals through the Board of Veterinary Medicine cannot provide interventions that exceed their respective human scope of practice. In a nutshell, a physical therapist may provide treatment interventions to animals so long as those interventions fall within the human scope of practice. In light of the NE regulations, and laws already enacted across the country, it is my hope that other states will also seek to open doors for PTs and PTAs to legally treat animals within an allowable scope of practice.

Three Reasons to Enact Legal Language for Animal Rehab:

1. Legal language provides practice protection to PTs treating animals. Most human practice laws were not intended to allow PTs to treat other species. Therefore PTs treating animals without explicit language in the law to support such practice are legally vulnerable.
2. Legal language, if appropriately crafted, will support term and title protection for physical therapy and physical therapists respectively. This has been an important goal for APTA in relation to PTs and PTAs in human practice and therefore should remain just as important for those treating animals.
3. Maybe most important, legal language provides an essential element of public safety. By having language codified into law, greater authority is provided to regulatory agencies to stop unlicensed, inappropriate, and incompetent individuals from treating animals. In short, we should all be just as concerned about the quality of care being provided to animals by others as well as our own. As a point of reference, competence and public safety are two of the most important elements that need to be assured when negotiating legal language with outside entities. If those two issues are not addressed during language negotiations then political tensions will inflame.

California Veterinary Medical Board:

The California Veterinary Medical Board (VMB) has scheduled a public hearing on the proposed regulatory language to mandate "direct supervision" over all non-vets treating animals on October 21-22, San Diego, CA. The CA proposal is of concern to the ARSIG for many reasons, but primarily due to its lack of foresight with current trends in state laws and regulations.

ARSIG Logo:

As mentioned in a previous newsletter, the ARSIG is looking to adopt a creative design for a logo representing the association. Why a logo? Pure and simple, logos are great marketing tools and they create a sense of being more official when displayed on public documents such as the SIG website, letterhead paper, brochures, and yes, even our new ARSIG conference booth. SIG officers welcome creative ideas from members; however, we will most likely need to seek professional assistance to accomplish our goal of adopting a logo within the next year.

Call for OPTP Submissions:

Our members need your expertise! Please consider submitting a fun clinical pearl, a critique of a recently published article, a unique case study, or an abstract of primary research.

Life is meant to be enjoyed…Happy Fall Season!!

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An Alternative Method To Assess The Canine Cranial Cruciate Ligament

Kirk Peck, PT, PhD, CSCS, CCRT

Recently I attended a continuing education course on the topic of canine sports medicine anatomy with laboratory dissection. As part of the course, James Cook, DVM, PhD,[1] introduced a new technique to assess the integrity of the cranial cruciate ligament (CCL). The test has not been statistically validated by randomized controlled studies; however, it does offer the canine rehab practitioner an alternative approach to triangulate data when clinically assessing the CCL for potential disruption.

Five-Step Process (Photos A-D):

1. Lay dog supine on firm surface (may require two people for support)
2. Flex hip and stifle to 90° and maintain in that position
3. Stabilize the femur of leg being tested
4. Internally rotate tibia on femur with firm pressure
5. Compare ROM bilaterally

Results: Excessive internal rotation of involved leg may indicate a disruption in CCL integrity. As seen in the photos, the right leg demonstrates excessive IR of the tibia on femur in comparison to the left leg (Photo B compared to Photo D). Results from this examination should be clinically compared to outcomes from other commonly used orthopaedic tests to assess the CCL.

Caution: Performing this test places the dog in an awkward position and requires a quick maneuver of the tibia that may be uncomfortable to the patient, especially if the CCL is disrupted. Therefore, caution must be used when performing the maneuver. In some cases, the dog may need to be sedated by a veterinarian before the test can be accurately performed.

Testing Procedure Cranial Cruciate Ligament Integrity

A. Normal left CCL—stifle in neutral position.

B. Normal left CCL—tibia internally rotates ~ 35°.

C. Torn right CCL—stifle in neutral.

D. Torn right CCL—tibia internally rotates ~ 65°.

Photos reprinted with permission from Kirk Peck.

REFERENCE

1. Cook JL, Warnock J. *Canine Sports Medicine Anatomy.* Paper presented at: 8th International Symposium on Veterinary Rehabilitation/Physical Therapy and Sports Medicine Preconference. August 4, 2014; Corvallis, OR.

ORTHOPAEDIC SECTION, APTA
2015 CSM Preconference Courses

Tuesday, February 3, 2015
Return to Function: Training Room Secrets for the Orthopaedic Clinician

The theme of this preconference session is to present progressive clinical reasoning skills utilized in professional and collegiate sports rehabilitation, rooted in evidence-based practice when dealing with the typical orthopaedic patient for the more advanced clinician. With the use of well-reasoned manual techniques and movement analysis, participants will augment their repertoire of clinical skills/tools in their orthopaedic toolbox. It is becoming more evident in the literature that problems in the spinal region can influence the outcome of managing orthopaedic conditions of the extremities and vice-versa. However, these techniques and approaches have not been widely presented as a combined manual therapy and movement science methodology to providing patient-centered care. It is a common pitfall for advanced clinicians that the interplay between spinal regions and related extremity symptom contribution is often missed, leading to ineffective interventions. Therefore, this course aims to provide the missing link in how to correctly identify contributions from these regions. Using manual, movement, and sports therapy examination approaches, the presenters will demonstrate how specific interventions are targeted to the cause and source of spine/extremity problems, thereby achieving desired outcomes. Case examples will be presented by physical therapists to help attendees better integrate how the authors successfully applied these concepts into their own orthopaedic clinical practice environment.

Wednesday, February 4, 2015
Functional Screening and Manual Therapy for the Lower Extremity

This one-day, hands-on, lab-based course will focus on screening for movement disorders of the lower extremity. The course will explore the use of manual therapy and therapeutic exercise techniques for the lower extremity, including the hip, knee, ankle, and foot. The morning session will focus on functional screening of movement disorders for the lower extremity and hands-on manual therapy and therapeutic exercise treatments for hip movement-related impairments. The afternoon session will be a hands-on laboratory session focusing on manual therapy and therapeutic exercise techniques for the knee, foot, and ankle regions to address functional movement impairments. The best available evidence will be integrated into all discussion and laboratory sessions. The intent of this course is to provide attendees with useful, clinically relevant information that can be immediately applied into various practice settings. Patient case studies will be presented.

Wednesday, February 4, 2015
Multimodal Physical Therapy and Interventional Pain Medicine in Managing Neck Pain

The objectives of this course are to review the physical therapy management of patients with persistent neck pain, particularly in therapeutic exercise. Neck pain is one of the leading reasons why patients visit primary care practitioners. The societal impact of this condition is widespread, fostering significant disability and socioeconomic burden. An episode of neck pain is typically well managed by multimodal physical therapy. However, while the disorder is typically recurrent, physical therapy management generally does not focus on reducing recurrent episodes. It will be argued that specific rehabilitation of the neuromuscular system may begin to address the problem of recurrence. In addition, there are a proportion of patients (in particular with whiplash associated disorders) who do not respond to conservative care. Physical therapists possess the skillset to identify those with neck pain of facet joint origin who will likely respond to facet joint interventions to avoid unnecessary invasive procedures. The speakers also will familiarize attendees with interventional spine procedures and discuss the role of the PT in this multidisciplinary environment.

Visit: http://www.apta.org/CSM/Overview/ for more information and to register!

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