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-

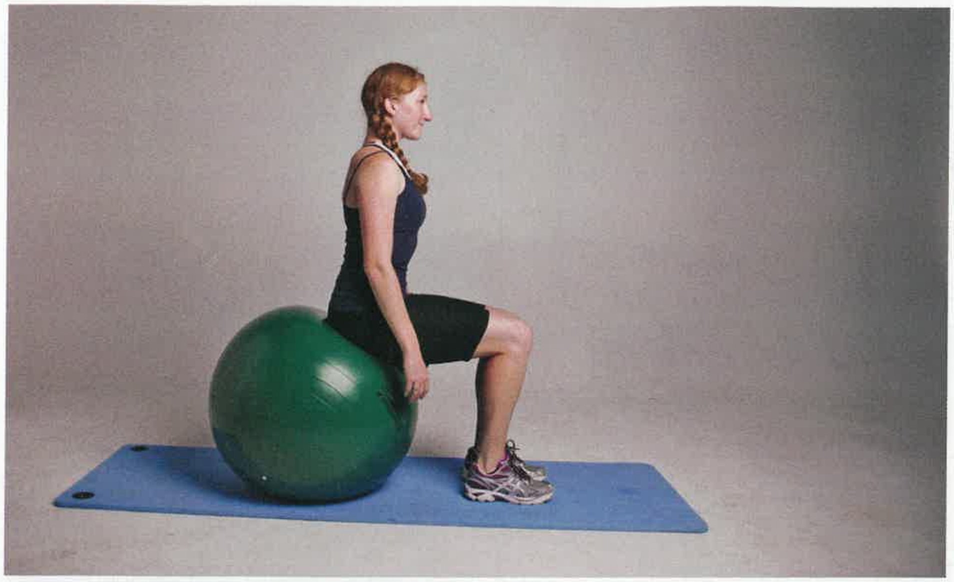

Figure 3. Balanced seated posture.

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

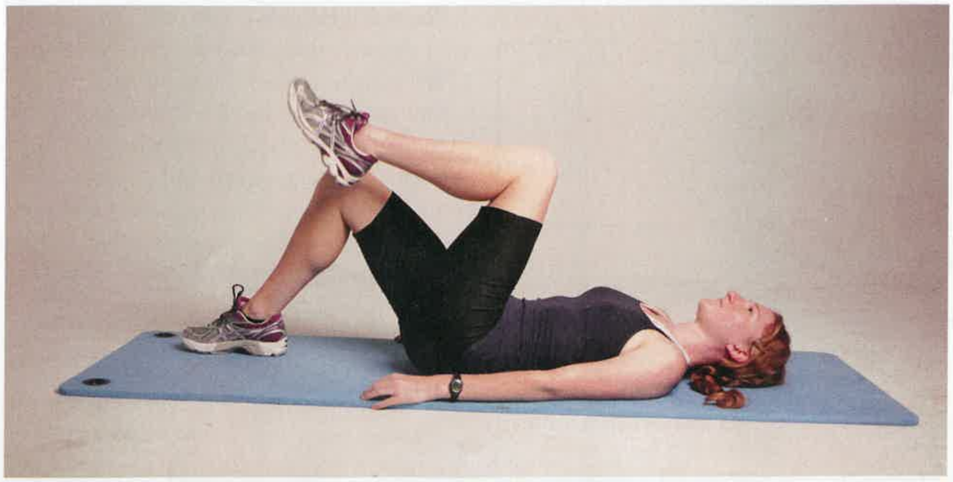

Figure 5. Single knee to chest.

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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