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THE MAGAZINE OF THE ORTHOPAEDIC SECTION, APTA

# PAIN MANAGEMENT

## SPECIAL INTEREST GROUP

### Clinical Application of Tai Chi for Management of Chronic Low Back Pain: A Theoretical Discussion

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**Disclosure:** As a long-standing proponent of Tricia Yu's Tai Chi Fundamentals® Training Program, the author is not an employee and/or stockholder in the business known as Tai Chi Health. The author does teach Tai Chi Fundamentals® continuing education workshops for personal profit and recently co-authored a book with Tricia Yu.

#### BACKGROUND AND PURPOSE

Chronic low back pain (cLBP) is a multifaceted biopsychosocial condition that poses a significant and costly health burden (eg, direct medical, indirect economic workforce, and quality of life costs). The lifetime prevalence of LBP is 80% to 85%, with recurrence rates ranging from 24% to 33%.<sup>1</sup> Compared to persons with acute and/or subacute LBP, persons with cLBP regularly use more costly health care services (eg, diagnostic imaging, spinal injections, surgery, and opioid medication) and are more likely to seek out complementary and integrative medical care.

Numerous physical, psychological, behavioral, and social factors contribute to the experience of cLBP. The International Association for the Study of Pain states that chronic pain is a worldwide epidemic fueled by several factors: (1) aging populations, (2) obesity, (3) lifestyles factors (eg, physical inactivity, nutrition, sleep hygiene, smoking, alcohol), (4) certain health conditions (eg, fibromyalgia, arthritis, depression, anxiety, mood disorders), and (5) stress from relationship problems or a history of physical, sexual, or emotional abuse.<sup>2</sup> Of these, the psychological (yellow flag) risk factors, such as depression, fear-avoidance, pain catastrophizing, and self-efficacy, are mitigating factors in the development and persistence of cLBP. Recognition of these challenging biopsychosocial factors has directed the medical community toward developing more psychologically-informed, multidisciplinary rehabilitation for persons with cLBP.<sup>3</sup>

Along with cognitive-behavioral strategies, the American College of Sports Medicine advocates aerobic exercise (muscular endurance), strengthening, stretching, and neuromuscular (functional) exercise for the conservative treatment of cLBP.<sup>4</sup> The 2012 *JOSPT* best practice management guidelines display strong evidence for progressive endurance and fitness activities and trunk coordination, strengthening, and endurance interventions for persons with cLBP (Table 1).<sup>1</sup> Tai chi chuan, an

ancient (13th century) Chinese exercise, offers the clinical community a functional exercise strategy to potentially meet all of the aforementioned guidelines.

Although numerous forms of tai chi (TC) exist, Yang-style TC is the most widely practiced and researched. While current literature supports the use of TC for balance and fall prevention, chronic health conditions (eg, fibromyalgia, osteoarthritis, osteoporosis, heart disease),<sup>5</sup> and psychological benefits (eg, stress, anxiety, depression, and self-esteem),<sup>6</sup> only one randomized control trial using TC for the management of cLBP has been completed to date.<sup>7</sup> The purpose of this paper is to describe and discuss TC as a meditative movement therapy that can readily address the numerous biopsychosocial aspects of cLBP. This paper will discuss TC mind-body principles in the management of cLBP, provide clinicians with strategies to implement TC into physical therapy clinical practice, and outline potential research avenues for the use of TC in the management of cLBP.

#### DESCRIPTION OF TAI CHI

Tai chi is a mind-body exercise rooted in Chinese (13th century) martial arts. Tai chi combines relaxed, fluid, 3-dimensional movement with a calm, alert mental state. It is a non-impact exercise that develops muscle endurance, flexibility, balance, and coordination.<sup>8</sup> Tai chi, like yoga and qigong, is also a meditative movement therapy. Meditative movement therapies are a new category of exercise (eg, aerobic, strengthening, or stretching interventions) defined by (1) some form of movement or body positioning, (2) a focus on (diaphragmatic) breathing, and (3) a calm state of mind with the goal of deep states of relaxation.<sup>9</sup> Tai chi focuses on the interactions among the brain, mind, body, and behavior, with the intent to use the mind to affect physical functioning and promote health.<sup>8</sup>

#### Biomechanical Analysis of Tai Chi Movements

As a mind-body practice rooted in the martial arts, TC provides the exact exercise demands needed by the person with cLBP, ie, progressive endurance and fitness training (aerobic) with a focus on trunk coordination, strengthening, and endurance (neuromuscular control); hip and ankle mobility (flexibility); and strengthening of the lower extremity, pelvic girdle, core, and shoulder girdle. The spine is held upright and in a neutral posture at all times. The extremity movements of TC avoid end-range of motion keeping optimal length-tension relationships reducing the risk of injury. The movements of TC help the client with cLBP exercise in ranges of motion that translate directly into function.

The weight-bearing posture of TC is well-tolerated by persons with cLBP (Figure 1). The TC posture fosters integrated movement from the core (proximal stability for distal mobility). Loose-pack positioning of the knee (~25°) creates a knee flexion moment that is controlled by the muscles of triple extension—quadriceps, hip extensors, and plantar flexors. This likewise flexes the hip releasing tension in the hip flexors—particularly the iliopsoas that is frequently either short/tight or facilitated (increased tone). Tai chi posture allows the client to achieve a neutral spine and engages the core musculature. Isometric contraction of core musculature and pelvic floor stabilize head, trunk, and arms to control the center of mass and keep spinal balance at all times.

Tai chi posture can improve the muscle imbalances fre-

Table 1. Clinical Practice Guidelines: Interventions for Chronic Low Back Pain<sup>1</sup>

INTERVENTION RECOMMENDATIONS	LEVEL OF EVIDENCE
<i>Centralization and Directional Preference Exercises and Procedures (repeated motions)</i> <ul style="list-style-type: none"> <li>• Improve mobility</li> <li>• Reduce pain symptoms</li> </ul>	Strong evidence
<i>Manual Therapy</i> <ul style="list-style-type: none"> <li>• Reduce pain and disability</li> <li>• Improve spine and hip mobility</li> </ul>	Strong evidence
<i>Progressive Endurance and Fitness Activities*</i> <ul style="list-style-type: none"> <li>• To promote submaximal fitness and endurance for the management of pain in patients with cLBP</li> <li>• To promote health and wellness</li> </ul>	Strong evidence
<i>Trunk Coordination, Strengthening, and Endurance*</i> <ul style="list-style-type: none"> <li>• To address movement coordination impairments</li> </ul>	Strong evidence
<i>Patient Education &amp; Counseling*</i> <ul style="list-style-type: none"> <li>• Promote activation philosophy</li> <li>• Decrease fear</li> <li>• Explain neuroscience of pain</li> </ul>	Moderate evidence
<i>Flexion Exercises</i> (combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking) <ul style="list-style-type: none"> <li>• Reduce pain and disability in persons with chronic low back pain</li> </ul>	Weak evidence
<i>Lower-quarter Nerve Mobilization</i> <ul style="list-style-type: none"> <li>• To reduce pain and disability</li> </ul>	Weak evidence
<i>Traction</i> <ul style="list-style-type: none"> <li>• Subgroup of patients with signs of nerve root compression</li> </ul>	Conflicting evidence

\*As mind-body neuromuscular exercise, tai chi is a relevant intervention strategy for persons with chronic low back pain.

quently seen in persons with cLBP, specifically the upper- and lower-quarter crossed syndromes. The upper-crossed syndrome creates inhibition of deep cervical flexors, lower trapezius, and serratus anterior and facilitation of upper trapezius, levator scapula, sternocleidomastoid, and pectoralis. The lower-crossed syndrome creates inhibition of abdominals, gluteals, and pelvic floor and facilitation of the iliopsoas and thoraco-lumbar extensors.<sup>10</sup> Tai chi postural alignment inherently addresses these muscle imbalances.

### Chinese Mind-Body Principles

The 3 traditional mind-body principles foster mental alertness (centering), proper body mechanics (effective action), and integrated movement from the core (tai chi energetics). Ancient Chinese texts say that TC movement is “rooted in the feet, powered by the legs, guided by the torso, and expressed in the hands.” Tai chi fosters stability (stand like a great mountain) and fluid movement (move like a great river).<sup>8</sup>

### Guidelines for Tai Chi Practice

**Mindfulness.** Tai chi practice involves striving to focus on the present moment. Mindfulness is the intentional and non-judgmental focus of one's attention on the emotions, thoughts, sensations, and actions currently taking place.<sup>8,11</sup> A *PubMed.gov* search “mindfulness benefits” (11/19/2015) yields 24 systematic reviews touting the psychological well-being benefits of mindfulness. There is evidence for positive effect for general health improvement as well as improvement from depression,

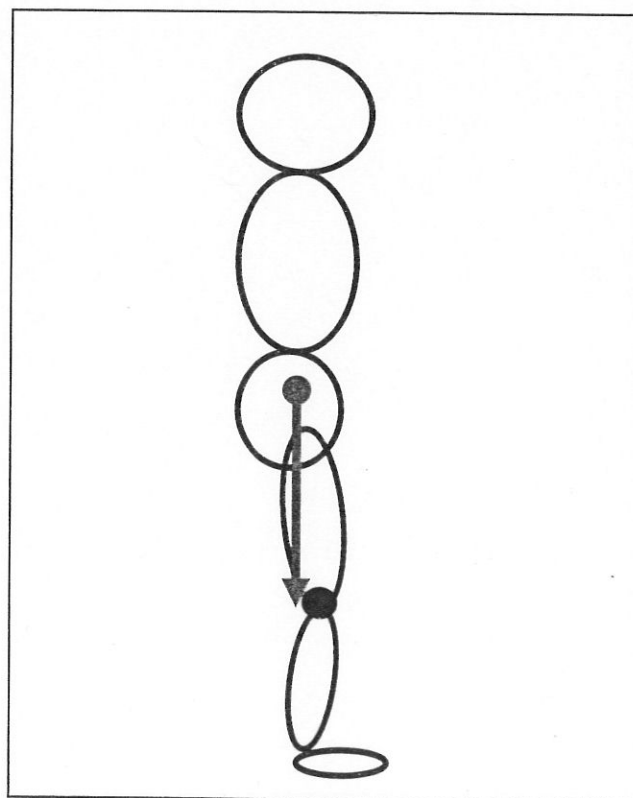


Figure 1. Tai Chi Posture – rooted in the feet, powered by the legs (quadriceps), directed by the torso, and expressed in the hands.

mental illness, anxiety, pain, and other chronic illnesses.<sup>6</sup>

**Postural alignment.** Tai chi posture (Figure 1) reminds us to maintain an upright spinal posture as we move throughout our day. The flexed knee posture readies us for action while supporting the natural primary (thoracic kyphosis) and secondary (cervical and lumbar lordosis) curves of the spine. Use of the powerful muscles of triple extension (eg, hip extensors, quadriceps, and plantar flexors) along with the 3-dimensional mobility of the hip joint further protects the spine as we use our upper extremities to complete the many tasks of our days.<sup>11</sup>

**Breath awareness.** At the center of all meditative movement therapies (eg, qigong, tai chi, yoga) is breath awareness. Persons with cLBP frequently use the diaphragm to splint the body while moving. This steals away the body's ability to efficiently oxygenate. Tai chi practice reminds us to slow down and inhale deeply to *nourish* and exhale completely to *cleanse* every cell in our being.<sup>11</sup> Likewise, normal respiration allows for cyclical movement of the spine—elongating the lumbar lordosis and thoracic kyphosis on inhalation and shortening the spine with every exhalation.

**Active relaxation.** Tai chi fosters a state of relaxed inner stillness while in motion. Active relaxation reminds us to integrate our inner calm and stillness while simultaneously taking on safe and effective physical action. For the person with a sensitized central nervous system, this active relaxation may actually assist in down regulation of the sympathetic nervous system, thus helping with pain management.

**Slow movement.** Tai chi movements are done slowly, deliberately, and with keen awareness. Slow movement builds strength and endurance. This allows the nervous system time to create optimal balance between agonistic and antagonistic muscles. It allows the brain time to integrate our joints, to craft the precise action we wish to accomplish. Slow movement, when repeated, and done in a relaxed way, prepares the nervous system for more dynamic, rapid, and even, ballistic functional activities. The slow movement of tai chi is the roadmap to motor efficiency and power, and precisely why many martial artists practice tai chi on the way to mastering their more explosive martial arts practices.<sup>11</sup>

**Weight separation.** Tai chi enhances dynamic control of the center of mass (postural control and balance). As a gross motor exercise, TC fulfills Sherrington's best practice guidelines for improving balance, strength, and coordination for fall prevention: (1) reduce the base of support (eg, tandem stance position and, if possible, standing on one leg), (2) move the center of gravity by controlling one's body position while standing (eg, reaching safely, transferring the body weight from one leg to the other, stepping up onto a block), and (3) reduce the need for upper limb support while in standing.<sup>12</sup> This renders TC a purposeful intervention in a variety of physical therapy settings—acute care, inpatient rehabilitation (subacute), skilled nursing facilities, nursing homes, outpatient clinics, and community-based programs.

**Integrated movement.** All TC movements are initiated by stabilizing on the weight-bearing surface and moving from the center of mass (core). Tai chi movements are based in proprioceptive neuromuscular facilitation fostering proximal stability for distal mobility. Tai chi movements can be taught in a neurodevelopmental sequence (eg, sagittal to frontal to transverse planes) allowing the learner to have incremental success, hence

keeping TC safe for the client with cLBP (Figure 2). The *Tai Chi Fundamentals (TCF) Training Program* developed in conjunction with physical therapists provides an accessible program for clients of all ages and functional abilities.<sup>13</sup>

## SUMMARY OF USE

As an integrated science, evidence-based practice (EBP) has been viewed as a 3-legged stool of the best scientific evidence, clinical expertise, and patient values and preferences. From an EBP standpoint, the scientific efficacy of TC for cLBP is still up for debate. A PubMed search using "tai chi and low back pain" (11/18/15) reveals 18 (n=18) articles (2003-present), with most (n=13) in the past 5 years. Only a few randomized control trials (n=5) exist with only one specifically using TC for the treatment of pain and disability in people with cLBP.<sup>7</sup> Furthermore, Tai Chi seemed to be an effective intervention for LBP, osteoarthritis, and fibromyalgia syndrome with less evidence for rheumatoid arthritis and headaches.<sup>14</sup>

Since 2007, an outpatient physical therapy clinic at the University of Wisconsin Hospitals and Clinics has been using simplified yang-style TC as the basis for a *Movement Awareness & Exercise Class for Patients with Chronic Conditions*. This group TC class (6 one-hour weekly sessions) is part of an interprofessional pain management clinic (MD, PT, psychology) that is attempting to foster optimal wellness for persons with chronic pain through client empowerment. Participants (n = 300) have ranged in age from 11-90 years (female > male). Clients were predominantly persons with chronic musculoskeletal pain (eg, LBP, osteoarthritis, FMS, and pelvic floor dysfunction) and the occasional client with neurologic diagnoses (eg, Parkinson's disease, multiple sclerosis, stroke).

Each class consists of a warm-up, TC training, and a meditation/qigong cool-down. Participants are trained using the 3 components of the *TCF Training Program*: (1) mind/body principles and guidelines for TC practice (previously discussed), (2) TCF movement patterns (Figure 2) and (3) TCF form practice.<sup>13</sup> Short-term outcomes from this TC exposure class have been monitored via simple tests and measures done at the beginning and end of the 6-week session. Outcomes include improved weight-bearing tolerance (as monitored by number of seated rest breaks and overall time seated/lying down per training session), improved single-leg standing balance (4-stage balance test), increased leg strength and transfers (30-second stand to sit chair test), decreased pain ratings over single treatment and over the course of the training sequence (Visual Analog Scale = 2). Patient-specific functional improvements have been monitored on an individual basis as well as or changes by outcome tools specific to diagnosis (eg, Oswestry for cLBP, fibromyalgia impact scale, etc.).

To date, this movement awareness class based on the medical model *TCF Training Program* has been well accepted by physicians, clients, and insurance companies in the Madison, Wisconsin, area. Because TCF was developed in collaboration with physical therapists, it provides a clear developmental progression for mastering Tai Chi basics and a gateway to all traditional TC lineages (styles). Likewise, because the local area is rich with TC programs, it is possible for clients to proceed from this exposure class to community-based TC programs. Clients are provided with home exercise programs, but can also purchase a TCF training DVD and/or written materials.<sup>6,16</sup>

## Basic Movement Pattern exercises

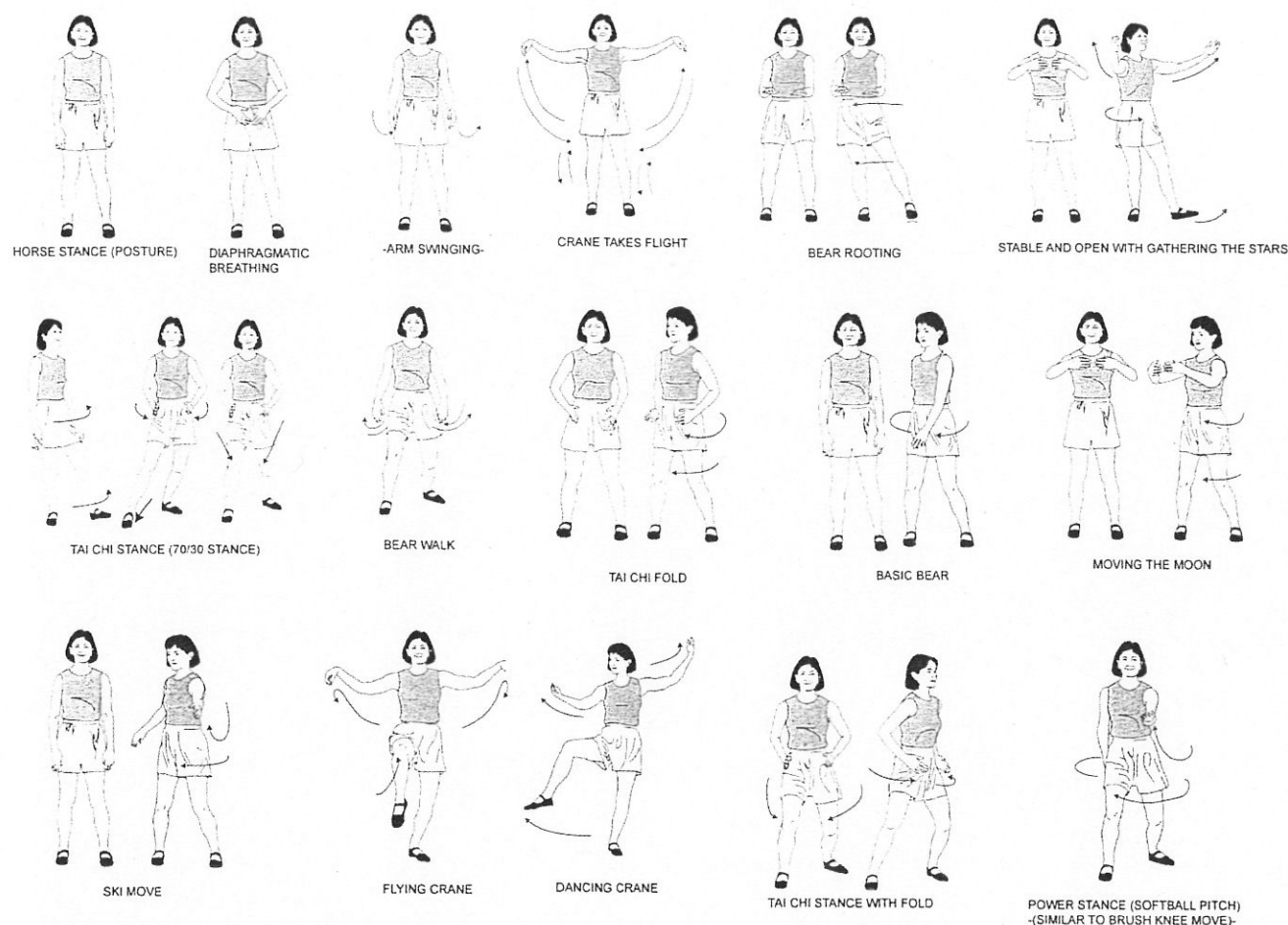


Figure 2. Tai Chi Fundamentals movement patterns.

### Tests and Measures Applicable to Tai Chi Practice

Whether employing tai chi interventions in research, clinical, or community-based practice environments, researchers and clinicians are obligated to measure functional baselines and monitor the progress of patients/clients. Table 2 displays common intervention categories, suggested tests and measures, physical therapy management goals, and dosing parameters applicable to monitoring clients engaged in TC practice.

### What to Expect at the Initiation of Tai Chi Practice

Tai chi participants should be informed that muscle soreness, specifically delayed onset muscle soreness (DOMS) in the antigravity muscles of the body, is an expected feature of starting any weight-bearing exercise program. Mechanically, the muscles of the anterior thigh (eg, knee extensors or quadriceps) will experience the greatest amount of DOMS. Other antigravity muscles that are commonly challenged with TC practice include gastrocnemius-soleus complex, gluteals (hip extensors and abductors), spinal extensors and abdominal muscles (transverse abdominis and obliques), and scapular stabilizers. Tai chi participants should expect that with graded exposure to muscle activation via the squatting, weight-shifting, and single-leg-stance activities of regular tai chi practice, the duration and

intensity of DOMS will decrease over time.<sup>11</sup>

From the literature, it appears that TC is safe. A systematic review of an adverse event (AE) in randomized trials evaluated 153 eligible randomized control trials (mostly older adults). Only 50 eligible trials (33%) included reporting of AEs; of these, only 18 trials (12% overall) reported an explicit AE monitoring protocol. While TC is unlikely to result in serious AEs, it may be associated with minor musculoskeletal aches and pains (eg, knee and back pain).<sup>15</sup> It is the opinion of the author (KH) that since TC practice promotes posture, mental concentration, and is done in a slow and controlled fashion, it is safe for patients with chronic health conditions.

### CLINICAL RELEVANCE

Physical activity and exercise is relevant to the client with cLBP. Aerobic exercise, strengthening, flexibility, and function (neuromuscular) are indicated for persons with cLBP to improve function (Figure 2).<sup>4</sup> As a mild-to-moderate form of aerobic exercise, TC is a therapeutic intervention suitable to a wide range of health care conditions and diseases. The weight-bearing posture of TC readily addresses impairments of the lower extremities and spine (eg, muscle strength, flexibility, balance, bone mineral density) thereby improving function and

Table 2. Categories of Exercise: ACSM Guidelines for Management of Chronic Low Back Pain

INTERVENTION CATEGORY and SUGGESTED TOOLS	PHYSICAL THERAPY MANAGEMENT GOALS CONDITION	MODES and DOSING PARAMETERS
<b>Aerobic fitness (endurance)</b> <ul style="list-style-type: none"> <li>• 6-min or 2-min walk</li> <li>• 400 m walk</li> <li>• Step test</li> </ul> <b>Ancillary measures</b> <ul style="list-style-type: none"> <li>• Blood pressure</li> <li>• Heart rate</li> <li>• Respiratory rate</li> <li>• Body-mass-index</li> </ul>	<ul style="list-style-type: none"> <li>• Increase <math>\text{VO}_2</math> max and ventilatory threshold</li> <li>• Increase peak work and work rate and endurance</li> <li>• Control blood pressure at rest and during exercise</li> <li>• Improve coronary artery disease risk factors</li> <li>• Increase caloric expenditure</li> </ul>	Large muscle activities (walking, cycling, aquatic therapies, tai chi) <ul style="list-style-type: none"> <li>• 60-80% peak heart rate</li> <li>• 40-60% <math>\text{VO}_2</math> max</li> <li>• rate of perceived exertion 11-16/20</li> <li>• 3-5 days/week (daily+)</li> <li>• 5-10 minutes progressing to 30 minutes; emphasize duration over intensity</li> </ul>
<b>Strength training</b> <ul style="list-style-type: none"> <li>• Chair test (30-second sit-to-stand)</li> <li>• Functional squats (reps to fatigue, good form)</li> </ul>	<ul style="list-style-type: none"> <li>• Increase strength of trunk and extremities</li> <li>• Improve posture and postural muscles</li> <li>• Maintain bone mass</li> <li>• Decrease fall risk</li> </ul>	Circuit training, free weights, resistance bands <ul style="list-style-type: none"> <li>• 60-80% 1RM</li> <li>• 1 set of 8-12 reps</li> <li>• 2-3x/week</li> </ul> Body weight resisted exercise can be used to achieve functional goals.
<b>Flexibility</b> <ul style="list-style-type: none"> <li>• Thomas (hip flexors)</li> <li>• 90/90 hamstring</li> <li>• Ely (quadriceps)</li> <li>• Straight leg raise or Slump test (neural)</li> </ul>	<ul style="list-style-type: none"> <li>• Increase and/or maintain painfree ROM</li> <li>• Decrease stiffness</li> </ul>	Individually prescribed stretching for muscles of interest. Neural dynamic (on/off gliding of nervous system) added as needed.
<b>Neuromuscular control (functional/balance)</b> <ul style="list-style-type: none"> <li>• ABCs</li> <li>• 10-M Walk test</li> <li>• Dynamic gait index</li> <li>• Functional reach</li> <li>• Single-leg balance</li> <li>• Timed Up &amp; Go (TUG)</li> </ul>	<ul style="list-style-type: none"> <li>• Improve balance</li> <li>• Improve gait</li> <li>• Improve activities of daily living</li> </ul>	Older adults (65+ years of age) at risk for falling should engage in neuromuscular (balance) exercise 2-3x or more days per week.
<b>PSYCHOSOCIAL ASSESSMENTS can also be useful for the client with chronic low back pain</b> <ul style="list-style-type: none"> <li>• Fear-Avoidance Beliefs Questionnaire (FABQ)</li> <li>• Self-Efficacy for Exercise Scale (SEE)</li> <li>• Tampa Scale of Kinesiophobia (TSK)</li> </ul>		

enhancing the patient/client's societal participation. Muscle contraction from the large muscle groups of the body are targeted in TC and can act as a pain-gate via endorphin release (endogenous analgesic effect). The meditative aspect of tai chi can be particularly helpful in addressing personal (psychological) factors that impact health. Furthermore, simplified and adapted forms of TC ensure that patients/clients with varying functional capabilities (eg, sitting, standing with side support, standing with walker support or free-standing) can readily engage in solo or group TC practice and profit from its many physical, mental, psychological, and social benefits.<sup>11</sup>

While research has validated the benefits of TC practice for many health conditions, few studies validate its use for individuals with cLBP. Still, TC has biological plausibility for the treatment of cLBP (clinical evidence) and has been shown to be valued by our clients/patients. Tai chi delivered on an individual- or group-based format in the clinic (or a community-based format) offers a functional exercise strategy to meet the challenges of cLBP. As a meditative movement therapy, tai chi is one example of a broad range of self-management mind-body

exercise programs that may be beneficial for persons with persistent pain.

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