

ARTICLE

# Management of Geriatric Low Back Pain with Tai Chi

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ABSTRACT

**Introduction:** Chronic low back pain (cLBP) among older adults is a complex, biopsychosocial condition that despite research efforts and innovative interventions remains a prevalent, disabling and costly condition. This case highlights the use of tai chi (TC) for persistent geriatric LBP. **Case Presentation:** A 68-year-old Caucasian female with cLBP, neuromuscular imbalances, leg weakness and fall risk was treated with a walking program (aerobic), manual therapy (mobility), lumbar stabilization (strength) and group TC class (neuromuscular function). **Discussion:** Research validates TC for a variety of older adult health conditions, but few studies demonstrated effectiveness for cLBP. This case outlines the use of a simplified Yang-style TC for management of persistent geriatric LBP. **Conclusion:** The addition of group TC to standard treatment for cLBP resulted in improved functional outcomes, decreased pain ratings and improved leg strength, flexibility and balance as compared to standard treatment for cLBP. Following the group TC class the client reported significant self-perception of recovery, and these functional and confidence gains eliminated the need for physiotherapy services for cLBP for three subsequent years. **Level of Evidence:** Therapy, level 4.

## 1. Background

Low back pain (LBP) is the leading cause of disability worldwide. LBP is increasing as a result of aging and is associated with smoking, obesity, sedentary lifestyles, and low socioeconomic status<sup>[1]</sup>. Mechanistic models of pathoanatomical spine degeneration as an explanation for geriatric LBP are weakly associated with pain intensity and/or function<sup>[2]</sup>. Age-related senescence of multiple body system and psychosocial factors better explain persistent LBP and disability found in older adults<sup>[1-2]</sup>.

The biopsychosocial model has advanced the treatment of LBP<sup>[1-2]</sup>. Clinical practice guidelines endorse non-phar-

macological and non-invasive management<sup>[3-5]</sup>. This paradigm shift directs clinicians to address physical (e.g. pain, strength, balance and mobility); psychological (pain catastrophizing, kinesiophobia, depression, self-efficacy); cognitive (executive function) and social (isolation, quality of life) consequences of LBP in older adults<sup>[2,5]</sup>.

A rapidly aging population demands sustainable self-management of cLBP and its associated health risks. Progressive graded exercise, neuromuscular trunk coordination, strengthening and endurance and patient education and counselling should be the first-line of treatment for persistent LBP<sup>[1-5]</sup>. Functional holistic interventions that improve aerobic capacity, strength, balance and mobility, and foster self-efficacy for self-management may limit

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ongoing or extraneous health care services for older adults with persistent LBP<sup>[2]</sup>.

Tai chi (TC), an ancient (13<sup>th</sup> century) Chinese mind-body exercise, offers a functional holistic exercise strategy to meet the needs of the older adult with persistent LBP<sup>[6]</sup>. TC is a non-impact exercise that fosters body awareness, postural control, strength, balance and functional and efficient movement patterns<sup>[6-7]</sup>. The purpose of this case report is to describe the effects of supplementing standard physical therapy (PT) interventions (e.g. aerobic exercise, manual therapy, lumbar stabilization) with group-based simplified Yang-style TC. The addition of TC to standard PT management led to improved functional outcomes and fostered self-management that eliminated ongoing PT services for a three-year period.

## 2. Case Presentation

### 2.1 History

The patient was a 68-year-old Caucasian woman (5' 8", 145 pounds, BMI=22.1 kg/m<sup>2</sup>) with chief complaint of persistent LBP and lower extremity (LE) weakness. The patient had a 30+ year history of LBP and four spinal surgeries over a three-decade period. Her surgeries included: (1) L4-5 discectomy/laminectomy, (2) L4-5 fusion, (3) repeat L4-5 fusion due to post-operative infection failure, and (4) scar tissue debridement surgery. The patient had several prior trials of PT with only modest outcomes (best prior self-perceived recovery was 80% of normal).

Thirty days prior to start of the final episode of PT care, the patient experienced a sudden loss of balance without a fall. This uncontrolled "jerking" motion created immediate onset of right (R) greater than left (L) sided LBP and self-described R LE 'sciatica.' LBP ranged from 4/10 (best) to 7/10 (worst) with spasm in R quadratus lumborum and R gluteal musculature. There was variable pain (3-5/10) in the distal right L5 and S1 sensory distributions. The leg pain was consistently present with the LBP and was mildly increased with coughing/sneezing and Valsalva maneuver. She denied signs and symptoms of cauda equine syndrome. Sleep was mildly disturbed (1-2 hours/night). Aggravating factors included all transitional movements (e.g. bed mobility, transfers, in/out of car), standing, walking, lifting, carrying and squatting. Alleviating factors included slow and guarded movements, lying supine with hips/knees flexed and feet flat on table (hook-lying) and self-selected anti-inflammatory strategies (e.g., ice, acetaminophen and relative rest).

### 2.2 Physical Examination

Physical examination demonstrated body structure and

function impairments consistent with cLBP including interfering pain, postural abnormalities (L lateral shift), muscle imbalance and weakness, reduced neural dynamics and lower extremity flexibility. (Refer to secondary outcomes discussion for all pre- and post-treatment body structure and function impairments measures). Functional limitations included insufficient hip and ankle balance strategies (i.e. poor balance with fall risk); limited ability to stand (< 30 minutes), impaired walking (< 1-mile), difficulty on stairs (less than one flight) and uneven ground (walk very carefully); and inability to freely perform activities of daily living and work.

### 2.3 Past Medical History

Reported medical diagnoses and associated medications were spinal osteoarthritis (acetaminophen), hypertension (Furosemide), hyperlipidemia (Lipitor), irritable bowel syndrome (MiraLax) with benign colon polyps, hepatitis (recovered) and newly diagnosed osteoporosis (Fosamax, Zoledronic acid (Reclast<sup>®</sup>). Nonprescription items included baby aspirin (81 mg), calcium supplements, and multivitamin. Other surgeries included colon polyp surgery (x2), cholecystectomy, thyroidectomy (benign tumor), and vaginal hysterectomy.

### 2.4 Social History and Goals

The patient was married, worked part-time (10-12 hours per week) as a realtor and was active in her community. The patient's goals were to reduce LBP and leg symptoms and return to all prior levels of function (personal/work/social). There was a strong desire to walk 2+ miles per day for cardiovascular health reasons.

### 2.5 Physical Therapy Diagnosis/Prognosis

The patient had signs and symptoms consistent with persistent LBP with referred leg pain and weakness; global mobility (bed mobility/transfers/gait), local tissue (joint/muscle/neural) mobility deficits and movement coordination impairments ('core' musculature). There were no red flags (biomedical signs of serious pathology), but yellow flags (psychological and behavioral factors) influenced PT management<sup>[3-4]</sup>. There was a past history of over-reliance on passive LBP interventions (e.g. hot pack, ultrasound, massage and medication) and tendency to slowly deviate from PT home exercise program recommendations. The patient had four previous episodes of PT (annually over a 4-year period). Each time the patient declined participation in balance retraining. Her newly diagnosed osteoporosis and a fear of falling/injury led to a willingness to participate in group TC to address her long-standing

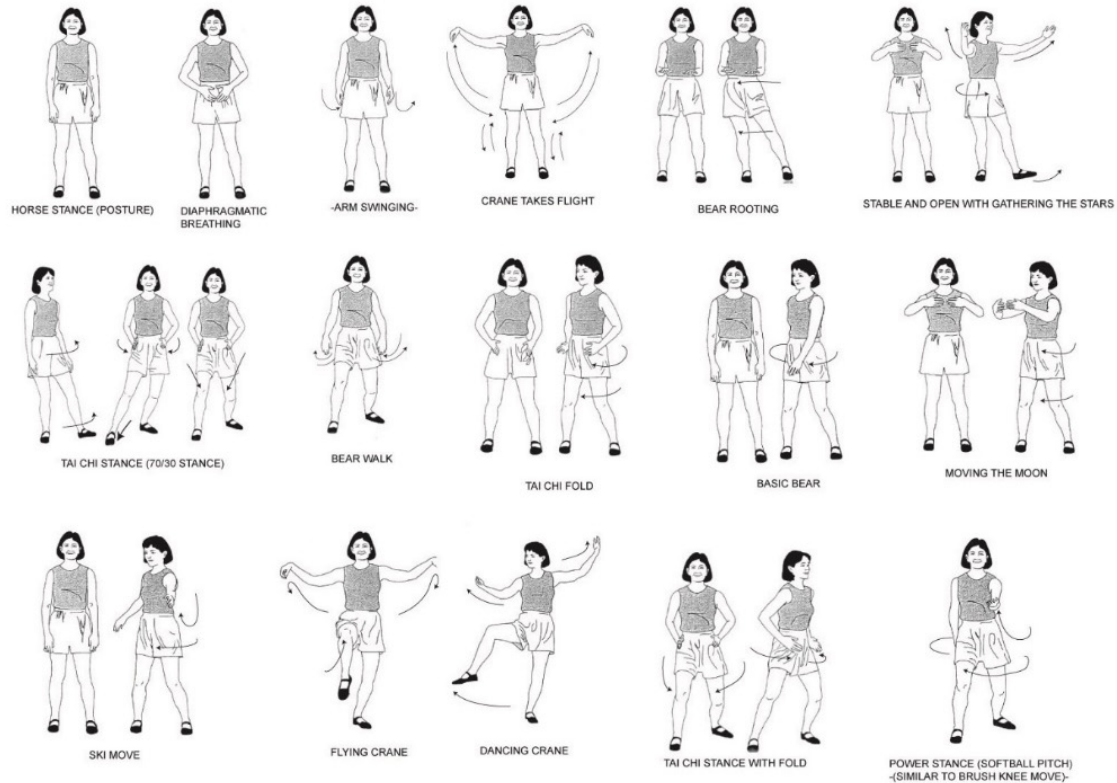


Figure 1. Tai Chi Fundamentals® Basic Moves [7]

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balance and mobility dysfunction.

## 2.6 Interventions

The patient received fourteen (n=14) visits of PT over an 8-week period via four individualized sessions and ten group TC classes. Standard in-clinic PT interventions included thermal ultrasound<sup>†</sup>, manual therapy, neural mobilization, muscle stretching and lumbar stabilization exercises. [NOTE: <sup>†</sup> While there is limited evidence for ultrasound for persistent LBP, patient value for this modality led to in-clinic treatment to promote patient buy-in for physiotherapy.] Manual therapy included joint-specific interventions of manual distraction at L5-S1, side-lying R facet lumbar gapping in flexion and sustained long-axis R hip distraction; soft tissue mobilization of the thoraco-lumbar fascia and gluteals; neural mobilization of the sciatic system and hold-relax stretching of involved LE musculature (one- and two-joint hip flexors, hamstrings, and calf musculature). Training in mindfulness, diaphragmatic breathing and guidelines for TC practice, occurred during group TC classes. PT provided education on osteoporosis risk factors, fall prevention and home safety infor-

mation.

Early PT visits (#1-3) served to reduce the patient's L lateral shift posture (McKenzie R side-glide) and referred leg pain and to re-establish LBP interventions (standard PT back care previously known to the patient). The home exercise program (HEP) consisted of a progressive daily aerobic walking program, lumbar stabilization (LS) with transverse abdominus drawing-in maneuver, pelvic floor activation and multifidi recruitment (supine, prone, and quadruped positions), supine 90/90 neural mobilization of the sciatic system, and LE stretching [3-4].

New to this episode of care (EOC) was a group (4-6 participants) TC class which met two times per week for 1-hour sessions over five weeks. The *Movement Awareness and Exercise Class for Patients with Chronic Conditions* is based on the Tai Chi Fundamentals® (TCF) Training program [7]. Developed in collaboration with physical therapists, this medical model of TC has three essential elements: (1) TCF movement patterns (*Basic Moves*), (2) simplified Yang-style *TCF Form* and (3) mind-body principles [7-8].

The TCF *Basic Moves* provide incremental and safe progression of exercise (Figure 1). Taught in a stepwise

neurodevelopmental sequence, the *Basic Moves* provide mid- to high-level balance challenge by: (1) moving the center of mass over the base of support, (2) reducing the base of support from double limb to single limb and (3) decreasing the need for upper extremity support<sup>[9]</sup>. The *Basic Moves* are qigong (“energy cultivation”) exercises that provide building blocks for learning the choreographed flowing sequence of TCF Form. Mind-body principles (mindfulness, diaphragmatic breathing, relaxed nonjudgmental slow movement) were embedded into each TC sessions<sup>[8]</sup>.

**Home Exercise Program** The patient’s final HEP included a 30-45 minute walking (aerobic) program 5-7 days per week, post-walk LE sciatic neural mobilization and lower extremity stretching. The TCF *Basic Moves* and *Form* practiced 4-5 days per week (15 minutes) provided leg strengthening, dynamic lumbar stabilization, postural control and balance exercises for spine health and fall prevention. The patient purchased a DVD for guided home TC practice<sup>[10]</sup>.

**Primary Outcome Measures** The lumbar component of the *Care Connections* (CC) outcome tool measured functional outcomes<sup>[11]</sup>. This patient-related outcome tool has functional items comparable to the better known Oswestry Low Back Disability Index (ODI)<sup>[12]</sup>. The 10-item *CC-lumbar* tool (walking, work, personal care, sleeping, recreation/sports, driving, lifting, standing, squatting, sitting) is scored on a 0 to 100 percent scale, with 100% implying optimal function. A 10-item *CC-lower extremity* (LE) tool (years 2, 5) captured gait characteristics specific to falls risk (up/down stairs and walking on uneven ground). The *CC-improvement index* captured self-perceived recovery on a 10-cm visual analog scale (VAS) and was converted to a percentage (0 to 100 scale).

**Secondary Outcome Measures** Key body structure and function impairments measured at intake and discharge became secondary outcome measures: pain (10-cm VAS), posture (lateral shift), lumbar range of motion (forward bending), squat capability, LE muscle flexibility and adverse neural tension.

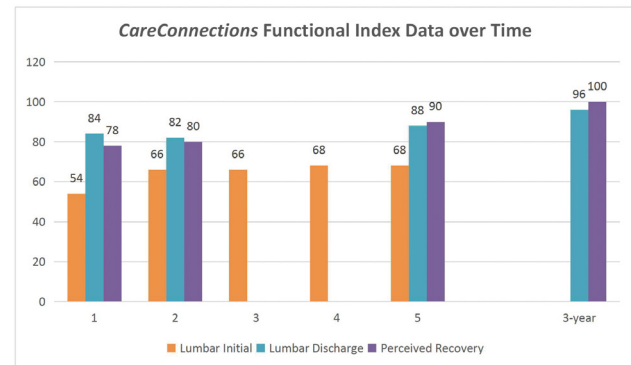
**Three-Year Follow-Up** Three years following the final episode of care, the patient’s functional status was appraised via the *CC-lumbar*, *CC-LE* and *CC-improvement indices*.

## 3. Results

### 3.1 Primary Outcomes

Figure 2 displays *CC-lumbar* outcome data over time (five consecutive years plus 3-year follow-up). The *CC-lumbar* functional index changed 30 percent (54% to 84%) in year

1 (14 individual visits), 16 percent (66% to 82%) in year 2 (12 individual visits) and 20 percent (66% to 86%) in year 5 (4 individual and 10 TC group visits). In year 2, the *CC-LE* functional index demonstrated a modest 14 percent change (68% to 82%), while the addition of TC in year 5 resulted in a distinct 24 percent improvement (64% to 88%). The patient reported her highest rate of overall perceived improvement (90%) in the year with TC training compared to the other years with complete data sets (78% [year 1] and 80% [year 2]).



**Figure 2.** *CareConnections*<sup>®</sup> Functional Index: Pre- and post-intervention Lumbar Outcomes and Perceived Recovery Index Over Time (8-years)

The *CC-lumbar* outcome tool lacks a published or minimal clinically importance difference (MDIC) or minimum detectable change (MDC). However, 8 of the 10-items are consistent with the more commonly utilized Oswestry LBP Disability Index, which has a MDIC of 12.8.<sup>12</sup> On all PT episodes of care, the client had improvements greater than 12.8% in *CC-lumbar* and *CC-LE* indexes. Adding TC to the standard PT plan of care for persistent LBP resulted in the largest functional gains.

### 3.2 Secondary Outcomes

Changes in key body structure and function impairments from intake to discharge at the final episode of care (14 visits in 8 weeks) were as follows. Pain (10-cm VAS) improved from 5.7 cm to 1.1 cm on a 0-10 cm scale. Left lateral shift with asymmetric LE weight-bearing posture was abolished by visit 4. Active range of motion of lumbar forward bending, measured fingertips-to-floor, improved from minus 13-inches to minus 3-inches. Functional squat ( $\frac{1}{2}$  normal depth or knee flexion to 72 degrees) improved to  $\frac{3}{4}$  normal depth squat (110 degrees). Straight leg raise (SLR), used to assess sciatic neural mobility improved 17 degrees (SLR = 53° to 70°) on the L LE and 18 degrees (SLR = 48° to 66°) on the involved R LE (< 6 percent R/L difference). Thomas test (hip joint angle) assessed 1-joint

hip flexors (iliopsoas length). The L LE improved 7 degrees (7° of hip flexion to neutral or 0°) and the involved R LE improved 9 degrees (13° to 4°). Tight hamstrings measured via supine 90/90 test (knee joint angle) improved 14 degrees (25° to 11°) on the L LE and 20 degrees (36° to 16°) on the R LE. Ely's test (prone knee bend), with a pillow under the pelvis to accommodate tight 1-joint hip flexors, was used to quantify quadriceps length. Knee joint angle improved 24 degrees (80° to 104°) on the L LE and 25 degrees (73° to 98°) on the R LE.

### 3.3 Three-Year Follow-Up

The patient did not return to the health care system for management of any aspect of her LBP for three years. The *CC-lumbar* and *CC-LE* outcome tools, assessed at an unrelated health care visit, both scored 96 percent three years after her last episode of PT care. At this time, the patient rated the self-perceived index of recovery (*CC-improvement index*) at 100 percent (i.e. complete recovery). The patient reported adhering to regular walking program and used several TCF *Basic Moves* as aquatic and land-based exercises. The patient enjoyed family life and worked part time as a realtor (10-12 hours/week) without difficulty. The patient returned to golf (18 holes), a recreational activity that she had not done in over 25 years due to her cLBP. The patient was not formally doing any TCF *Form* practice nor had she sought out a community-based TC program.

## 4. Discussion

Persistent LBP limits older adults physically (ability to execute routine tasks, exercise or sleep), psychologically (feelings of sadness and irritability, fears about worsening health, loss of hope or depressive symptoms) and socially (isolation, inability to pursue hobbies, reduced self-efficacy) [2,5]. Several factors play a role. Biological influences include age-related sarcopenia, energetic limitations due to senescence of multiple body systems and/or poor nutrition, and maladaptive pain neuroprocessing due to chronicity of pain [2]. Cognitive changes (age-related decline in memory and executive function) and suboptimal social connections may influence the older adult's perception of pain and level of physical activity [2].

Current practice guidelines for the management of persistent LBP are multi-faceted. Physical interventions include aerobic exercise, strengthening, range of motion (flexibility), trunk coordination, neuromuscular control and balance retraining [1-4]. Psychological interventions encompass patient education in the form of pain neuroscience education [13], cognitive-behavioral therapy and

mindfulness [1-3,5].

Strength of evidence (SOE) research validates TC for a variety of conditions relevant to older adults [6,14]. Specific to this case, TC has excellent SOE for balance impairment, falls prevention, osteoarthritis and aerobic capacity; good SOE for cardiovascular conditions and strength; and fair SOE for osteoporosis (bone density) and well-being [6]. Few randomized control trials have evaluated its use for LBP [15-17]. A systematic review by the Agency for Healthcare Research and Quality (2016) found that TC was more effective than wait-list control for low back pain intensity (moderate SOE) and function (low SOE) [18]. While several studies support TC for chronic pain, few randomized control trials have evaluated its use for LBP [19]. More high quality trials are needed for recommendation for persistent LBP.

The treatment protocol was based on the movement control approach - a treatment-based classification system used by PT for patients with chronic LBP [4]. Standard PT interventions addressed both local mobility (neural, soft tissue and joint) and global stability impairments (coordination and strengthening of regional musculature relevant to activities of daily living) [4]. Personal practice of TC provided leg strengthening and balance retraining (hip strategies) relevant to the patient's falls risk [6,9,20]. Mind-body skills training and group TC addressed psychosocial aspects of care including mindfulness, cognitive retraining for pain-related fear, and exercise self-efficacy [1-3,5,9].

When confronted with osteoporosis and the risk of fall-related morbidity and mortality, the patient accepted integration of TC into the plan of care. Data strongly support TC as a fall prevention and balance tool in older adults [8,14,20-21]. Simplified Yang-style TC provided a functional exercise strategy capable of addressing the biopsychosocial complexity of the patient's cLBP. Mind-body principles (e.g. mindfulness, postural alignment, breath awareness, active relaxation, slow movement, weight separation and integrated movement from the core) were emphasized (Table 1) [7-8]. Group TC provided a mechanism for mild aerobic exercise, dynamic lumbar stabilization, leg strengthening and flexibility, and functional neuromuscular control, all with the added benefit of contextual (social) support [5,14].

Participants in this group TC class learned TCF *Basic Moves* (Figure 1) over ten 1-hour classes. These exercises can be adapted (e.g. seated, walker support or optional side support versions) to foster safe progression to high-level balance challenge for the older adult with mobility compromise [8]. *Basic Moves* served as incremental building blocks for learning the choreographed flow of TCF *Form* practice. They can be dosed (repetitions, fre-

**Table 1.** Tai Chi Mind-Body Principles: Definition and Guidelines for Tai Chi Practice and the Benefits for Persons with persistent Low Back Pain and Falls Risk <sup>[8,26,28]</sup>

Mind-Body Principles	Definition	Benefits for LBP
Mindfulness (centering)	Nonjudgmental awareness of the present moment	<ul style="list-style-type: none"> <li>•Somatosensory awareness of body in space (helps with brain re-mapping in persons with chronic pain)</li> <li>•Enhanced flow of movement</li> <li>•Relaxation and stress reduction</li> </ul>
Postural Alignment	Body upright with symmetrical weight-bearing; emphasis on structural biomechanical alignment of the body	<ul style="list-style-type: none"> <li>•Slightly flexed knee flexed posture promotes relaxed lumbar posture (inhibits hip flexors to reduce lordosis)</li> <li>•Alignment fosters efficient, functional movements with economy of effort</li> </ul>
Breath Awareness	Diaphragmatic breathing (that is natural and relaxed)	<ul style="list-style-type: none"> <li>•Induces subtle spinal movement that aids kinesthetic awareness</li> <li>•Improved gas exchange (oxygen/carbon monoxide)</li> <li>•Internal organ motility</li> <li>•Promotes calmness and body awareness</li> </ul>
Active Relaxation	Awareness of all parts of the body (at one time)	<ul style="list-style-type: none"> <li>•Release of excessive tension</li> <li>•Efficient (minimal) effort to move the body</li> </ul>
Slow Movement	Moving at a slow rate of speed	<ul style="list-style-type: none"> <li>•Builds strength and endurance</li> </ul>
Weight Separation	One leg is full/solid (yang) and one empty/soft (yin)	<ul style="list-style-type: none"> <li>•Aids balance/coordination</li> <li>•Builds bone density via load (Wolff’s law) and piezoelectric effect of muscle contraction</li> </ul>
Integrated Movement (from the core)	Movement is initiated at the (core pelvis) or dantian (center of mass) such that movement is fluid motion (like a string of pearls)	<ul style="list-style-type: none"> <li>•Protects the lumbar spine as head, trunk and pelvis remain aligned and move as a single column over the base of support</li> <li>•Enhancing spinal stabilization</li> <li>•Provides solid foundation for upper extremity function</li> </ul>

quency and duration) like other strengthening and balance exercises.

TCF *Basic Moves* most relevant to the patient (ones regularly used for long-term aquatic and land-based exercise) included:

(1)*Horse Stance with Diaphragmatic Breathing* for mindful postural alignment, optimal lumbar, hip, knee and ankle posture with emphasis on relaxation;

(2)*Bear Rooting* for weight-shifting, hip abductor and knee extensor strengthening and progression to single leg balance;

(3)*Tai Chi 70/30 Stance* with anterior-posterior weight-shifting readily applied to functional activities of daily living;

(4)*Tai Chi Fold* and its variations (Basic Bear, Ski Move) for hip mobility and improved gait and;

(5)*Flying Crane* for single leg strengthening and balance with internal (upper extremity) perturbation for high-level balance challenge.

Many factors influence adherence to exercise in older adults (socioeconomic status, educational levels, gender, marital status, ‘good’ health and cognitive ability, fewer depressive symptoms and supervised programs) <sup>[22]</sup>. Older adults adhere to exercise programs to stay independent

and safe in activities of daily living. They value exercise and fall prevention programs that promote self-efficacy and self-management <sup>[23]</sup>. Promoting exercise and self-management strategies for older adults with persistent musculoskeletal pain (particularly geriatric cLBP) should be the common goal of all clinical and community-based exercise programs <sup>[24]</sup>.

TC delivered in an individual or group format (clinic or community-based class) offers a functional exercise strategy to meet physical, psychological, cognitive and social needs of older adults with persistent LBP and falls risk <sup>[5-6]</sup>. Persons performing TC may expect some delayed onset muscle soreness (DOMS) in anti-gravity musculature (quadriceps, gastrocnemius-soleus complex, hip extensors and abductors) and postural stabilizers (spinal extensors, abdominals, scapular muscles) <sup>[8]</sup>. TC is a safe exercise; it promotes postural awareness, mental focus and slow, controlled movements that most persons with chronic musculoskeletal conditions can tolerate <sup>[25]</sup>.

TC is a health promoting (salutogenic) exercise. TC masters assert that it provides a practical framework for living a more holistic life by integrating body, mind and spirit <sup>[26]</sup>. Its mind-body principles help the TC practitioner learn about self, so they can better interact with others.

The social support and positive interactions (sense of belonging) that come from group TC exercise also merits further evaluation by the scientific community. Data suggests exercise alone reduced the risk of LBP and associated disability; but exercise adherence in the presence of persistent LBP is a formidable barrier for many clients<sup>[27]</sup>.

### Study Limitations

This is a case study (level 4 evidence) with limited generalizability to management to all geriatric cLBP. The clinic assessment tool for LBP in this case study (*CC-lumbar* outcome tool), lacks a published MDIC. Comparing the *CC-lumbar* to the Oswestry Low Back Disability Index may not be valid. No formal self-efficacy or balance evaluation tool was administered at any point during patient care. At the 3-year follow-up, the patient reported adhering to a regular walking program and use of TCF *Basic Moves* as aquatic and land-based exercises. As compared to prior trials of standard PT care, TC may have eliminated the need for ongoing PT services; but whether TC mind-body skills or *Basic Moves* attributed to her high level of function is inconclusive.

### 5. Conclusion

With aging baby boomers, the management of geriatric LBP will be a costly and arduous task for healthcare for decades to come. Much effort has addressed the identification and treatment of the pathoanatomical (biomedical) factors in LBP. Implementation strategies addressing psychosocial risk factors and exercise adherence issues are essential to management. This case report potentiates the use of TC for long-term management of older adults with persistent LBP. The addition of TC to standard back care resulted in significantly decreased pain (5.7 cm to 1.1 cm) and improved body structure (physical impairments) and functional outcomes. Long-term functional recovery was high (96%). The patient reported excellent quality of life (100% improvement index). Simplified TC with its mind-body principles is accessible to patients of all ages and functional abilities. Group TC may address the cognitive, psychological and social needs of older adults with persistent LBP. Group TC practice and billing procedures may offer substantial savings to the health care system versus individualized patient care. Formalized research to determine the efficacy and cost-effectiveness of individual and group TC for geriatric LBP is warranted.

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