

Chronic Osteoarthritis and Tai-Chi Exercise Observations 2000-2026: Strengths, Opportunities, Trends and Implications for Mitigating this Rapidly Growing Global Health Burden of Immense Pain and Functional Disability

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ABSTRACT

Osteoarthritis, a chronic health condition resulting in considerable disability, particularly in older adult populations, not only impacts life quality significantly and severely, but is also strongly associated with the persistence of intractable pain, depression, feelings of helplessness, and a high falls injury risk. This narrative overview synthesizes the knowledge base published over the last 25 years regarding what is known about Tai Chi – a mind-body form of exercise in the context of reducing lower limb osteoarthritis joint derived disability and its associated risk of incurring one or more injurious falls, as well as bone fractures, while fostering sedentary behaviors and chronic disease exacerbation, persistent pain and depression. To this end, while many reports are favourable, most rely on small group Eastern located observations, rather than Western medicine venues. Thus, while collectively showing Tai Chi may have an enormous positive impact on reducing distress and increasing function and autonomy among older adults living in the community and diagnosed as having painful lower limb osteoarthritis, more widespread study of other groups and cultures is indicated. In the interim, they specifically suggest the increasing numbers of these older adults expected to suffer in the future from osteoarthritis of the knee or hip or both can safely practice one or more forms of Tai Chi exercise with the expectation that consistent applications will enhance their mobility, reduce their pain and depression, plus gait and standing instability, and possible injurious falls, while reducing fatigue, even if surgery is indicated as well as forthcoming.

Keywords: Aging, Falls, Hip, Intervention, Knee, Older Adults, Osteoarthritis, Pain, Tai Chi

Introduction

Osteoarthritis, a widespread highly disabling chronic destructive globally prevalent health condition affecting one or more freely moving joints such as the hip and knee joint's is usually progressive and deemed irreversible. Prevalent among the older adult population, and growing in prevalence globally due to a combination of increases in aging, injury, and obese populations, among other factors, this multi-factorial disease, which commonly advances slowly, often spreads from a single joint to include multiple joints and physical as well as neurological and cognitive body system deficits. At the same time, osteoarthritis not only commonly evokes persistent unrelenting discomfort and distress in many cases, but severely limits daily mobility and self-care functions.

Complicating its management is not only age, but the fact osteoarthritis affects all joint tissues including the surrounding muscles. Often associated with a pre-existing or an emergent cognitive state of centrally derived pain sensitization and what is termed neuropathic-like pain, these accompanying highly noxious states of burning, stabbing, and tingling hyperalgesic type pain symptoms are often treatment resistant [1-3].

Consistently associated with the localized breakdown of key joint structures such as its force sensitive cartilage tissue shock absorbing lining located at the ends of the bones such as the knee and hip bones and others, plus parallel pain provoking degrading alterations in the adjacent marginal subchondral bone mass, and joint capsule lining membrane of synovial tissue containing joint lubricants as well as the potential to produce noxious inflammatory enzymes, effusion, and pain mediators, the disease is frequently accompanied by varying degrees of joint stiffness, decreased range of motion, structural instability, and swelling. In

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addition to that, various accompanying degrees of joint mechanical derangement, as well as deficits or damage to affected surrounding joint structures, such as postural or supportive muscles, joint tendons, ligaments, and menisci, the synovial tissue lining of the joint capsule, plus extrinsic and intrinsic joint sensory receptors and nerve networks can engender the presence of persistent joint inflammation, lower than desirable pain thresholds, and damaging nerve remodeling [4-6].

Unfortunately, unlike most other chronic health conditions that can be treated quite successfully and identified early on, osteoarthritis damage is not only multilayered but often asymptomatic and challenging to diagnose until its destruction is structurally or symptomatically evident. Moreover, even though the disease affects millions among the global aging population, since its origins remain in question, treatments are often not targeted at all specifically, and commonly osteoarthritis treatment options tend to be those that are solely palliative, applied late in the disease cycle, and to date largely fail to avert ongoing day to day joint damage, nor the emergence of post surgical neuropathic pain.

Indeed, while laboratory research flourishes, most current observations offer no well tested regenerative options that can be applied clinically with any degree of certainty at the present time and common clinical solutions employed largely in the West remain ineffective or unproven, as well as often posing a considerable degree of risk to the older high age affected adult suffering severe joint derangement and bouts of intractable nerve derived pain. Moreover, at this point in time, almost none portray clinical evidence of any permanent respite or reversal impact of cartilage damage-the hallmark of osteoarthritis pathology [6,7].

At the same time, mounting evidence points to a projected exponential rise in osteoarthritis cases by 2050 as society ages and caring for the older adult in the presence of osteoarthritis of the knee in particular, the most common disease site, may be especially problematic in those with chronic pain that is easily provoked, plus those who are either obese or frail. In addition to increasing a tendency to adopt a sedentary lifestyle, in the case of any age associated fears of movement and an associated tendency to fall, the affected older adult with lower limb osteoarthritis who wishes to reside independently in the community may be placing themselves at risk for injury and further debility by relying on passive treatments or those that are stressful, even if they have had joint replacement surgery or are healthy. Moreover, in addition to impeding walking, standing, stair climbing and descent, and chair rising ability, this health condition is often prevalent in those with severe multi-morbidities such as heart and metabolic diseases or some form of longstanding lower leg deformity, alongside neuropathic-like pain manifestations. Thus, the affected older adult may not be able to exercise the lower leg muscles in a traditional manner, or undertake many forms of electrotherapy because pain can often be evoked by the lightest touch, such taping a TENS electrode. With very few options for relief, a sizeable percentage of cases with persistent centralized pain manifestations may not only duly encounter a heightened risk for the adoption of sedentary behaviors, but may shun most forms of advocated exercises such as stretching or aerobic exercises due to movement 'fears.

They may consequently incur a state of increased obesity or frailty, muscle and bone mass losses, muscle weakness and poor endurance possible local and centrally derived sensory mechanistic declines or disturbances that favor structural worsening of the already compromised joint's and that may in turn evoke pain at rest as well as pain on moving or in response to light touch [4].

Since joint health depends in part on intermittent exposure to physiological levels of joint compression and decompression, as well as the supportive quality of surrounding muscles and ligaments, plus effective timely well modulated reflexive protection against sudden as well as repetitive joint loads, the sedentary older adult with lower limb osteoarthritis may indeed suffer an excess loss of joint structural integrity, and a pervasive cascade of pain provoking inflammatory responses. As the disease progresses, and in the case where adults in severe pain are forced to utilize more medications than not, these individuals may become further impaired if they fail to appreciate the impact of excessive joint usage, or prolonged numbness, a correlate of neuropathic pain. They may also fall quite readily due to a combination of muscle sensory deficits plus ligament damage, poor balance and cognitive interactions that can duly interfere with the desired timely generation of much needed carefully modulated inherent protective motor reflexes or those that may induce healing rather than destruction [4,5].

In addition to the presence of neuropathic type pain that may evoke a sudden or recurrent falling event, and with this, further joint injury, affected older adults who use non-prescribed or multiple medications incautiously may similarly experience more rather than less pain. As well, surgical interventions may fail to alleviate central oriented or mediated osteoarthritis pain, or independently provoked neuropathic pain [7].

On the other hand, even though it may be possible to repair a damaged joint successfully in the future, the success of this effort may yet require attention to the ongoing need for joint protection and maintenance of optimal motor control reflexive neural mechanisms such as those that can be carefully developed through long term exercises, for example by exercise associated reductions in muscle atrophy. That is, whether or not targeted reparative efforts or joint replacement surgery or both are forthcoming, exercises such as those that foster muscle strength, balance and functional abilities may prove paramount in protecting the osteoarthritis damaged joint from harmful joint degrading impacts, while lessening pain and falls injury risks at all disease stages.

Moreover, those that can also reduce anxiety, depression, sleep challenges, obesity, joint instability, and fatigue, and do not involve undue stress on the affected joint's, cartilage erosion, bone mass declines, or cognitive disturbances, and can be done in the home with low impact and intensity independent of an instructor, may prove highly valuable. Unfortunately, despite the aforementioned challenges associated with osteoarthritis among the older population, plus an enormous parallel impact on social as well as economic health associations, decades of related research, have not as yet succeeded in developing an effective safe pharmacologic remedy to limit or eliminate the key biological changes as well as those that may interact

to exacerbate the rate of progressive disabling symptoms and signs of those osteoarthritis cases where neuropathic-like pain manifestations may commonly preside. In addition, the presence of severe sharp pain or numbness, as well as possible joint nerve damage clearly poses an excess falls risk if it affects balance control, joint stability, and recovery thus potentially inducing devastating outcomes in its own right [8].

Moreover, some medications may not only be injurious to joint tissues and others directly, but may inadvertently result in increasing confusion as well as suboptimal lower leg kinaesthesia and the inhibition or slowing of protective reflex responses that cannot adequately counter the risk for falling and further injury. However, it appears exercises or interventions that can reduce the need for pain medication and can foster better mood states and sleep quality, as well as joint stability, such as Tai Chi appear to offer highly promising preventive as well as remediable results. In addition to helping restore function and ameliorate pain in severe cases of the disease, surgery may be obviated, but if needed- more successful in the face of dedicated efforts to build up the patient's postural and muscle strength capacity and moderate the extent to which post operative neuropathic pain is likely to emerge [9].

Yet, in addition to clinical and experimental evidence that suggest a role for Tai Chi in attenuating some if not all of the key causes, mediators, or moderators of any prevailing impaired cartilage cell biology, bone pathology, poor muscle coordination, sensory dysfunction, and muscle atrophy multiple clinically oriented health benefits are not likely to be realized if Tai Chi is an overlooked or poorly applied treatment option or is recommended but not practiced. However, if adopted and practiced Tai Chi may enable 'normal' healing and repair processes, exercise endurance, weight reduction, if desirable. Additionally, improvements in health perceptions, joint flexibility, and muscle power are anticipated as well as decreases in the severity of anxiety, depression, and pain and medication dependence [10-14].

Importantly, Tai Chi- a form of stress-free exercise may subdue rather than provoke pain, fatigue, or discomfort, often associated with other exercise forms that may leave the high age osteoarthritis case with more, rapid painful joint attrition than desired, rather than less. Many older adults with osteoarthritis also suffer from joint inflammation, cardiovascular diseases, and poor bone health, and cannot safely undertake activities that are stressful or fatiguing without high pain risks, and a tendency to adopt avoidance behaviours. As well, certain antidepressants often employed to reduce pain may not prove risk free, and exercises that increase the risk of injuries such as falls [such as recommendations to walk outdoors, or take pain medication before exercising, or work through pain need to be avoided at all costs [12].

On the other hand, exercises that are gentle, as well as those that mimic normal daily movements, and that can currently be done indoors, as well as outdoors, with no equipment and independently of a gym or trainer, if required, would appear highly warranted as well as helpful and relevant in the context of the older adult who wants to reside in the community and wants to avoid being sent to residential care. Moreover, those exercises that can simultaneously allay anxiety and depression, those that can help to offset obesity, and those that can improve

life quality and functional capacity are especially advocated. While many forms of exercise exist, this current paper focuses on examining the results of representative studies that discuss the efficacy of Tai Chi - a mind-body exercise performed at moderate intensity, and said to be especially practical and useful for seniors. In particular, it examines its observed potential for ameliorating neuropathic-like hip or knee pain in the older knee osteoarthritis case. The value of this Chinese based martial arts derived therapeutic mode of intervention for fostering overall life quality of the older osteoarthritis adult with either hip or knee joint osteoarthritis or both is specifically highlighted.

Tai Chi, a category of the broader QiGong health approach appears of high value because it can be undertaken as a preventative as well as a restorative form of therapy. For example, in cases of lower leg osteoarthritis, this exercise mode appears to have a strong ability to improve balance, postural alignment, aerobic capacity, and pain, as well as reducing stress and injurious movements and other disabling osteoarthritis correlates depicted in Table 1.

Current Objective

To explore the above outlined themes.

Rationale

Osteoarthritis the most prevalent chronic disease involving the disruption of many joint tissues as well as painful inflammatory processes, including biomechanical abnormalities and challenges that impact function may be prevented, ameliorated if not reversed to some degree by one or more Tai Chi impacts and their interactive structural and functional health affirming processes, as opposed to more isolated focal mechanistically targeted Western medicine end-stage treatments or therapy directives and a deficit of preventive goals.

Method and Procedures

To establish whether the application of Tai Chi is likely to afford older adults with severely painful lower limb osteoarthritis – selected data for this strictly narrative topic overview were downloaded from those available on the PUBMED, GOOGLE SCHOLAR, and PUBMED CENTRAL electronic data sources deemed to house valid and clinically sound research studies. To examine trends over time, the years searched ranged largely from January 1, 2000 – May 1, 2026 if relevant using the key words: osteoarthritis, pain, treatment, and Tai Chi. All potential articles were first scanned for relevance, and excluded if they were non-English based articles, or proposals for study, or did not focus on lower limb osteoarthritis or its analogues. Because this review sought to make a strong case for Tai Chi in the context of home-based preventive care for older adults with signs of neuropathic-like osteoarthritis pain, associated empirical studies related to community-based environments and samples of older adults, rather than institutions were explored if exposed to Tai Chi as a standalone approach to remediation. All forms of Tai Chi were deemed acceptable, as a single best application approach remains elusive. As well, all forms of research were deemed acceptable. The voluminous literature could not be reported on though and readers are encouraged to examine the cited systematic reviews highlighted in this overview for a more in-depth analysis. Data are presented in narrative form by design rather than by a systematic review due to numerous data gaps, methodology diversity, and limited uniformity.

Table 1: Selected problems commonly faced by older adults with chronic lower limb osteoarthritis derived disability that could potentially be addressed impact fully by varying holistically oriented Tai Chi applications

Physically derived challenges of:	Psychologically derived challenges of	Other correlates impacting wellbeing include:
Articular cartilage damage Bone pathology Balance deficits Chronic pain Gait impairments Hyperalgesia Inflammation/swelling Impaired function Joint coordination deficits Joint instability Joint mal-alignment/deformity Joint stiffness/limited flexibility Muscle weakness/atrophy Muscle contractile deficits Nerve entrapment/damage Neuropathy/neuropathic pain Limited joint range of motion Muscle reflex inhibition Obesity, increased muscle fat mass Poor endurance capacity Poor posture Proinflammatory cytokine responses Reduced kinaesthesia/proprioception Structural joint damage Synovial membrane inflammation	Avoidance behaviours Brain function changes Centrally mediated pain Depression and/or anxiety Fatigue, and lack of energy Fear of falling Feelings of helplessness Kinesiophobia-pain related fear Mechanical hyperalgesia Limited confidence in ability to function/ control pain Pain catastrophizing Sleep disturbances Stress	Chronic health condition flares/pain Innate joint damage linked immune responses Loneliness Maladaptive coping Restrictions in meaningful activities Self-care challenges Socioeconomic hardship Social isolation Social functioning decreases

Key Results

Cumulative Findings

Data show osteoarthritis, the key topic of present concern clearly remains an immense global burden and challenge and one that implies an immense need to explore remedies that can prevent or ameliorate its disabling features and costs in most elderly populations. Strategies that possibly retard its possible persistent pain manifestations and progression with few side effects or safety concerns are scarce, however, despite a strong need. Indeed, most current 2026 articles that focus on tertiary care detail surgery and stem cell-based therapies to retard or reverse the disease, or some form of pharmacologic palliative or biologic oriented remedy rather than not and are not deemed safe for all, nor effective or clinically proven. Indeed, with more than a century of research, no evident curative measure or one that can mitigate osteoarthritis effectively in any joint prevails as of May 2026, and even with promising findings in animal models of cartilage regeneration, a failure to appreciate osteoarthritis affects the whole joint, including muscles and ligaments, plus inflammatory and emotional factors, success in the real world remains elusive at best. By contrast, it appears possible harm and effects that can exacerbate the human and economic burden can ensue from an oversight into the nature of osteoarthritis pain plus its mitigation via the unrestricted usage of some medical agents, such as opioids, but this issue is rarely addressed or discussed in most current osteoarthritis clinical reviews or management contexts. Moreover, it appears, regardless of a possible role for the emergence of centralized pain in the long-term worsening of osteoarthritis joint attrition, older adults with chronic joint inflammatory signs may require treatments that do

not provoke cartilage damage or pain mediators. Indeed, data speak to possible disease correlates that can readily induce pain such as possible nerve damage or compositional alterations that provoke the secretion of pro-inflammatory products if activated inadvertently, for example by overusing the joint when analgesia is administered. In turn, cases that experience excess cartilage degeneration impacts due to disease associated subnormal reflex responses may conceivably exhibit frequent pain flares plus further joint derangement, behavioral changes, and a high risk for injurious falling and falling recurrently [10,15].

On the other hand, it appears a carefully construed treatment program that reduces the chances of their potential inflammatory reactions and interactions may prove beneficial even if surgery is forthcoming [9,16].

For example, Tai Chi practice widely touted to specifically foster several attributes below may help counter severe osteoarthritis manifestations quite readily including:

- 1) A more relaxed mind, calmer spirit, and improved self-image.
- 2) Pain relief and an enhanced sleep quality.
- 3) Motivation for self-management and joint protection.
- 4) The efficacy of projected efforts to replace or ‘grow’ cartilage, bone and muscle tissues.
- 5) Improvements in blood oxygen level and flow, as well as blood pressure ratings.
- 6) Multiple functional and psychological related life quality/independence benefits.

As well, probable benefits may extend to those listed below in Table 2.

Table 2: Specific post Tai Chi outcomes that should be valuable and that warrant more well-designed prospective study among vulnerable older adult osteoarthritis subgroups, for example those with neuropathic hip or knee osteoarthritis.

- + Activity tolerance
- + Affective status
- + Arthritis self-efficacy
- + Aerobic capacity
- + Cardiovascular health
- + Coping ability
- + Degree of fatigue
- Fears of moving/falling
- + Functional ability
- + General health status
- Inflammation
- Opioid addiction
- **Pain**
- + Quality of life
- + Sleep/related biological impacts
- + Social wellbeing
- Stiffness
- Stress levels
- + Weight control

That is, even if publication bias among the posted 250 topical PUBMED articles listed from 2003-2026 cannot be ruled out, and the translation of research conducted largely in China may not translate equally to Western educated older adults a wealth of evidence attests to the safety and high efficacy of Tai Chi if practiced regularly by the adult with osteoarthritis disability as well as the healthy adult. In this regard, in addition to improvements in osteoarthritis disablement, Tai Chi exercisers are also reported as being satisfied with their general health status, self-care and functional abilities to a high degree. These important clinically relevant findings that are generally replicated in controlled studies show self-report pain intensity scores to decrease significantly compared to control interventions with Tai Chi practice and to do so in multiple dimensions as reported by Naderi et al. A further finding by Yip et al. showed increased post Tai Chi arthritis self-efficacy scores, as well as pain, and improved quadriceps and hamstring muscle strength that may heighten balance control [17-20].

In addition, its gentle stress inducing enhancement of local joint circulation and lubrication may attenuate inflammation [11], while fostering favorable cognitive and immune system effects along with lower pain levels and better physical function. Additional improvements in muscle endurance may emerge alongside more favorable bone mineral density scores, and decreased falling fears and degrees of movement restraint. Also shown are improvements in depression as well as sleep and life quality [21-26].

Additional Observations

As well as the stand-alone study observations highlighted above, available meta-analyses have generally supported the potential of Tai Chi to ameliorate multiple diverse osteoarthritis manifestations [28-30]. Most continue to conclude Tai Chi

participation improves osteoarthritis disease-specific symptoms of: a) pain and stiffness; b) physical dysfunction; c) walking limitations; d) poor postural control; e) mental health; f) joint range of motion as well as neuromuscular system coordination deficits [31-34].

Indeed, Chen [35] noted older adults with chronic painful osteoarthritis who participate in Tai Chi programs do appear to safely improve their ability to manage their pain. Additional data revealing Tai Chi practice may specifically stimulate bone growth and strengthen connective tissue [36] may account for some of the pain benefits of Tai Chi, while improving joint sensibility and balance and lubrication plus falls fears [11,19, 37-40]. In addition, Tai Chi practitioners may experience stress as well as distress reductions, an improved ability to concentrate, and adopt a tranquil rather than an anxious fearful mind state as well as significant pain and stiffness benefits [40-43].

In sum, most published data consistently show Tai Chi practices are effective for the older adult with chronic osteoarthritis who wants to remain active and is one that can generally be carried out readily in multiple venues at low cost and with a high safety record. Moreover, most Tai Chi reports indicate this form of exercise is one that can be recommended for older adults who are facing multiple health problems and where fears of movement and distress are commonplace. Widely practiced in China and other parts of Asia for many centuries as an art or self-defense mode of self-care, its practice tends to impact a host of physical and mental health attributes and evoke muscle related improvements as well as almost all of the lower leg osteoarthritis disease attributes portrayed in Box 1 favorably and meaningfully including decreased suffering and fears of moving. Indeed, the potential physical benefits of Tai Chi observed to date including improvements in strength, increased energy, and increased control over one's own health, without applying undue stress to the joints, often help to improve joint stability muscle activation, and favourable cognitions and function. This sets the stage for possible mitigation of the intensity of the disease impact, and ensures a more promising state for overall wellbeing even if the disease is not reversible and potentially explains why Tai Chi is often chosen preferentially by the older osteoarthritis sufferer as discussed by several authors [11,19, 44-46, 55]. In terms of mechanisms of influences favourable widely reported impacts on health as well as on a diseased joint tend to stem from the combined favourable effects of Tai Chi movements on joint lubrication, limb flexibility, muscle coordination, balance, and muscle strength [10] plus its overall holistic approach that integrates the physical, emotional and spiritual dimensions of health [44].

Tai Chi is also observed to improve brain metabolism as well as muscle energy in older adults [45] alongside biomechanical benefits that may help stabilize the joint or act as a gateway to other forms of exercise and that potentially modulate descending opioid associated pathways and reward/motivation systems favorably [46-49]. The practitioner of Tai Chi can thus expect cognitive as well as localized impacts that reduce or attenuate neuropathic pain, as well as multiple benefits comparable to those of other exercise modes of similar duration if applied for at least 8-12 weeks [50]. Especially anticipated are an improved ability to withstand harmful impacts on the joints of the lower extremities

[48, 51-55], improvements in joint proprioception or kinesthesia, falls self-efficacy, plus strength of the lower limb muscles and their timely contractile functions to a high degree [53,54,56].

Tai Chi adoption and its regular practice also appear to improve balance [62,64], foster stair ascent muscle coordination, plus life quality [67,68]. Its dedicated practice is consistently found to reduce joint stiffness, and inflammation, while improving physical as well as cognitive health, muscle activation, and postural control [60-72]. As per Wu et al [73] it thus appears Tai Chi is indeed a form of 'medicine' in its own right as far as its ability to improve physical as well as osteoarthritis physical and psychological health realms, including joint status and intractable pain [74].

Discussion

As of May 10 2026, it is clear osteoarthritis the most common joint disorder continues to cause untold distress among senior members of all societies. A condition that is growing in prevalence and extent of disability among many older adult populations remains largely incurable however, despite a wealth of research into its causes and solutions for more than 100 years. Its incalculable personal costs as well as public health costs demands more attention to mitigating this burgeoning situation, and if not curable- attention to harm reduction strategies as opposed to risky palliative solutions. Currently in the West, in particular, however, osteoarthritis treatment among the elderly are largely focused on its amelioration via medications, injections, and surgery. Although somewhat successful, this approach does not stress or account for the importance of self-care and other forms of health promotion that may raise the ability of the older osteoarthritis sufferer to overcome any disease associated sedentary tendencies that possibly exacerbate joint vulnerability and pain rather than affording any long-term relief. On the other hand, Tai Chi, interchangeably known as Tai Chi Chuan, an ancient health-promoting martial art form that has been recognized in Asia as an effective form of arthritis therapy for centuries may yet prove of high value in Western contexts where it is not well studied or commonly advocated, but where increasing attention is being drawn to those osteoarthritis cases suffering associated multiple pain and multinorbidity manifestations, including central as well as peripherally generated neuropathic pain, immobilizing fears and distress [75,76].

Indeed, our 25-year long exploration of the peer reviewed data shows an increasing volume of careful research largely affirming that low to moderately intensity type of exercise programs that follow Tai Chi precepts or their modifications are not only safe [75], but tend to foster both health in general, as well as joint and body pain intensity reductions [48]. They may foster healing, rather than not, due to their low impact movements and muscle patterns that are often quite similar to those used in daily life. Importantly, these movements embodying Tai Chi appear well accepted and especially appropriate for older individuals often affected by centrally dominant painful osteoarthritis symptoms alongside chronic health challenges, such as heart disease. They appear to help strengthen the muscles as well as the balance of an affected lower leg quite markedly [57,58] along with a possible reduction in falls or other adverse impactful joint located events [59,60].

They can also be applied to safely enhance aerobic and functional capacity, plus self-care, cognitive states, and desirable social interactions and participation, while improving life quality [61-63].

As per Liang [77] Tai Chi may enable older adults and others with chronically disabling lower leg osteoarthritis to live better lives and possibly to have better long-term outcomes even if surgery is still needed or is indeed forthcoming. Self-reports of enjoyment by older adults participating in Tai Chi indicate this form of exercise may not only prove structurally beneficial, but is easy to adhere to as well as being flexible enough to accommodate the needs and preferences for exercise by the individual quite successfully. Participants who feel infused with energy as a result of its practice may also be able to continue their desired activity levels and life goals more harmoniously and independently than not for years to come at minimal cost [42].

These movements can also be effectively combined with resistance training exercises to enhance effects of exercise in older adults and/or integrated with other approaches [78] such as a multi-dimensional patient education program to specifically communicate the potential benefits of Tai Chi, and the risks and consequences of failing to protect the joint in this way or others [81].

Clinical Implications

In the case of rehabilitation for severe lower leg osteoarthritis that is not relieved by traditional approaches, it appears movements associated with Tai Chi, which incorporate deep breathing, while maintaining an upright posture [if possible] are designed to soothe rather than evoke stress, and are hence of great potential importance in the context of osteoarthritis treatments, where it is crucial to place no undue strain on the affected muscles, joints, and connective tissues within and surrounding the diseased joints, and where cognitive stress is a well accepted disease mediator. However, although several studies highlight the use of specific Tai Chi modes or remote Tai Chi delivery methods, we believe discussions with the affected older adult regarding their condition, beliefs, pain behaviors, pain distribution, responses to prior interventions, and need for protection behaviors to reduce harm, are however strongly indicated, as are comprehensive health and joint status evaluations [78].

In particular, clarity here is very important given that many lower leg osteoarthritis cases with severe pain will predictably fail to participate in activities that are perceived as difficult and pain provoking or are of questionable benefit to them, in their view or actual experience, as well as inaccessible if visually or hearing impaired, as well as technology access limitations. They may underestimate the benefits of empirically observed benefits of Tai Chi exercise on strength, proprioception and postural stability or pain as well as on overall joint damage and disablement in the absence of sound patient-provider communications [64,65].

In reality though some who may understand Tai Chi observed outcomes, may yet discount the multiple potential Tai Chi benefits in favor of medication or surgery, especially if they are unfamiliar with mind-body therapies or do not know any cases who have benefited, even if they want to reduce their medication intake as well as pain, and hence the provider can play an

enormous role in raising awareness, and offering a supportive tailored step by step to Tai Chi exercise adoption program rather than any full blown or remotely delivered generic approach. Their demeanor and own beliefs can be instrumental here and should help to reduce anxiety steadily and progressively, while building the patient's self-care self-efficacy and motivation.

As well, with a growing volume of current research showing high rates of risky medication effects, plus inadequate health literacy among many older adults and others with low health access as well as technological skills these attributes if ignored may compromise societal efforts to mitigate lower leg osteoarthritis suffering, as well as Tai Chi osteoarthritis sufferer participation quite markedly and negatively and should be borne in mind by providers as well as trainers. Moreover, providers should be especially wary about believing us the ability of all older adults to employ or prefer technology to harness impactful Tai Chi attributes as this may depend on who is affected and in what way and whether the treatment is sufficiently personalized or not. More insights here by clinicians are also potentially essential as well in our view, given possible cultural, educational, traditional, economic, and social factors that may mediate Tai Chi acceptability and adoption or non adoption.

In the interim, it appears that if coupled with other desirable interventions, such as joint protection education and related measures, Tai Chi and its underlying premises of disease as an energy imbalance affecting the whole body may help to foster overall independence and a wide array of meaningful functional improvements, as well as possibly attenuating cartilage damage, sensory nerve provoked inflammatory responses and pain mediators to a higher degree than standard interventions that target isolated symptoms [87].

Thus, how the application of Tai Chi may differ from Western approaches should be carefully communicated as indicated to the patient since this may make the difference between a life of quality versus immense suffering [4,10].

Research Implications

To further advance this line of inquiry more profoundly, and in light of the tremendous current and forthcoming global burden of osteoarthritis (<https://www.who.int/news-room/fact-sheets/detail/osteoarthritis>) more objectively oriented analyses that examine the direct impacts or interactions of various modes of Tai Chi on bone and cartilage attrition, gait biomechanics, serum located inflammatory markers, and balance in high age adults with excessive degrees of joint and central pain manifestations and others are strongly indicated. Also indicated are comparative prospective studies, studies that assess the role of fear and suboptimal pain and functional self-efficacy perceptions, and that test the added value of joint protection education, footwear, non intrusive assistive devices, nutritional neural and bone protective agents, and other mindfulness or lifestyle-based therapies on injury protection versus some predictable joint tissue degrading influence in their absence.

Concluding Remarks

Despite gaps in the literature and few Western oriented applications designed to examine the benefits and shortcomings of Tai Chi in general, as well as in osteoarthritis contexts, we

conclude this mode of holistically oriented mind-body therapy offers a wide ranging relatively risk free method of alleviating undue suffering in those older adults with intractable pain and possible lower leg instability without incurring risks of pharmacological derived or invasive approaches, and most other forms of possibly stressful fatiguing exercises that may increase joint damage and heighten movement fears.

We further conclude that in light of the strong need to offer some degree of relief to the many often under detected older adult cases with severe osteoarthritis pain, or depression who could advance to a highly disabling state, a growing volume of literature attests to the high potential for Tai Chi exercise participation not only for both reducing the degree of persistent pain and distressful symptoms, but for reducing the overall disease burden including its biological underpinnings [87].

We further Assert

Optimally insightfully designed Tai Chi practices may assist in helping challenged older adults with intractable osteoarthritis pain symptoms, poor balance, joint stability, possible joint deformity or mal-alignment to not only reduce their pain significantly, but also their deficient health and activity profiles, and possibly their intrinsic abilities to avert injurious micro day to day joint impacts plus falls in the face of deficient lower leg muscle control [55,82].

Indeed, although conceptualized recently as a 'wound that does not heal' [55], Tai Chi, an aerobic mode of mind-body practices that employs slow choreographed movements shows multiple promising associated osteoarthritis benefits such as: pain and fatigue amelioration, better functional fitness, sleep health quality improvements, possible improved obesity management and control, postural stability, improved joint alignment, and motor control enhancements may help to offset further joint attrition and pain [55,66,82,86]

Important too are anticipated short-term as well as long-term post Tai Chi training improvements in the realm of mental health status, as well as joint instability, function, and systemic inflammation. Its safety record and ease of use when compared to most other modes of intervention is likely to induce more widespread acceptance as well as rates of exercise adherence when compared to other exercise modes, and hence more profound mind and body benefits than most other forms of exercise [55].

However, as with other forms of osteoarthritis treatments, those conducted under the guidance of a suitably qualified geriatric practitioner and health provider or Tai Chi instructor that encourages long-term usage [82,83] may prove more beneficial in terms of self-reported stiffness, pain and its management or tolerance than generic or non tailored approaches [33]. Their degree of function, as well as balance, muscle composition and strength benefits when combined may help avert falls fears and recurrent falls, regardless of mode of application, and should be applied sooner rather than later and followed up accordingly, rather than being ignored or overlooked [80,84,85].

Closing Remarks

Although more research using carefully designed ecologically sound protocols are crucial to support Tai Chi as a potential key

mainstream osteoarthritis mitigation intervention, in general, as well as in cases with central pain manifestations, it appears substantive degrees of osteoarthritis disease mitigation may be anticipated in the biological, behavioral, and neural spheres of influence consequent to the adoption of carefully designed and targeted regular Tai Chi practices no matter the mode, or geographical, cultural, or high age of the affected adult.

Applied as an individualized as well group, community, or population level application, Tai Chi when conducted regularly can be expected to offer many osteoarthritis sufferers some degree of mitigation and life quality enhancements, and have thus been recommended in national and international clinical practice guidelines as a safe non pharmacologic treatment for older adults with severe lower limb osteoarthritis.

Fostering low impact social as well as functional, cognitive aging, plus psychological well being and life quality benefits at low cost, declining degrees of osteoarthritis associated suffering and public health care costs may be duly anticipated.

Advocacy efforts to ensure adequate reimbursement, plus clear personalized culturally and linguistically appropriate communications that empower older adults in the decision-making process is especially likely to enable more effective Tai Chi acceptance and adherence, as well as efficacious evidence based ethical and holistic practices and socially just non injurious treatment of mind and body options for those with severe pain manifestations.

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