Efficacy of *Tui-na* Massage in Combination with Conventional Medication for Treatment of Canine Osteoarthritis: A Randomized Controlled Clinical Trial

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ABSTRACT

The objective of this study was to determine whether *Tui-na* massage in combination with conventional medication (CM) constitutes a more effective treatment for canine osteoarthritis than using CM alone. A total of 47 dogs with radiographic changes consistent with osteoarthritis and already on CM were enrolled in the study. The dogs were randomly assigned to either control (n=24) or experimental treatment groups (n=23). Dogs in the Treatment Group received a weekly *Tui-na* massage for five weeks, whereas those in the Control Group were seen twice, five weeks apart. All subjects continued their CM during the study. Outcome data included scores for range of motion (ROM), walking frequency/duration, quality of life (QoL), pain and weakness collected pre-trial and at study termination. Comparison between groups after five weeks demonstrated significantly greater improvement for the Treatment Group for all outcome data scores: ROM ($p = 1.48\times10^{-10}$), numbers of walks per day ($p = 0.015$), total walking time per day ($p = 2.75\times10^{-5}$), QoL ($p = 1.43\times10^{-8}$), pain ($p = 3.01\times10^{-10}$) and weakness ($p = 1.63\times10^{-9}$). The study findings demonstrate that regular *Tui-na* treatment can serve as an effective coadjuvant in a multimodal treatment and offer statistically significant benefits for dogs suffering from OA.

Keywords: traditional Chinese veterinary medicine, *Tui-na*, massage, osteoarthritis, canine

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ABBREVIATIONS

CM	Conventional medication
GABA	Gamma-aminobutyric acid
MT	Manual therapy
NSAIDs	Nonsteroidal anti-inflammatory drugs
OA	Osteoarthritis
QoL	Quality of life
ROM	Range of motion
TCVM	Traditional Chinese veterinary medicine
TN	*Tui-na*

Osteoarthritis (OA) is a chronic degenerative disease that affects a considerable percentage of the geriatric population around the world. This progressive and destructive process manifests with damaged articular cartilage along with bone remodeling which affects joints creating muscle weakness, loss of function and chronic pain.[1] The disease can be differentiated between early and late changes. In early stages there is loss of elasticity and greater permeability of water which increases chondrocyte stress and exposure to degradative enzymes. In late stages, there is progression to an increase in bone formation, microfractures followed by callus formation, stiffness and restricted motion. Secondary infiltrative inflammation in the soft tissues adjacent to the affected joint create laxity of ligaments and muscle weakness.[1]

Johnston et al. stresses the view of OA as a complex condition, where not only deterioration of the joint with pain and dysfunction is involved but biochemical, physical and pathologic alterations have to be considered.[2] Furthermore, cartilage has a limited self-healing capacity making the treatment of damaged articular cartilage even more challenging.[3-6] Treatment, therefore, depends on many factors which requires a multimodal therapy to palliate them. Commonly this includes a variety of analgesics including combinations of nonsteroidal anti-inflammatory drugs (NSAIDs), intra-articular injection (e.g. steroids, hyaluronic acid), nutritional supplements and physical rehabilitation.[2] The final result culminates in marked reduction of patients' quality of life.[3]

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In traditional Chinese veterinary medicine (TCVM), OA is a degenerative disease that involves bones, tendons/ligaments and muscles which presents with the clinical signs of pain and stiffness and is referred to as Bony *Bi* syndrome. Based on TCVM theory, the *Zang-fu* organ, Kidney, controls, among other things, bone, marrow and the central nerve system (CNS). Tendons and ligaments are controlled by the *Zang-fu* organ, Liver, while Spleen, among other things, controls muscles. Pain is created by *Qi* and Blood Stagnation; related to OA's effects on the joints. The most commonly seen TCVM patterns associated with *Bi* syndrome include Kidney *Qi* Deficiency, Kidney *Yin* and *Qi*/*Yang* Deficiency, Painful (Cold) *Bi* and Fixed (Damp) *Bi* syndromes. The general weakness and muscle wasting, *Wei* syndrome, can also be commonly found alongside *Bi* syndromes.[7]

Tui-na (TN) or *Tui-na-an-mo*, is a Chinese manual therapy used for preventing and treating disease and is one of the 4 main branches in traditional Chinese medicine.[8] Primary treatment objectives include helping to soothe joints and sinews, improve Blood flow, soften local tissues, reduce pain and during this process it can help to restructure dense connective tissue.[8] The TN techniques, similar to acupuncture, use fingers instead of needles to apply pressure/stimulate acupuncture points and Channels while other techniques such as stretching or manipulation to improve range of motion (ROM) are applied to the limbs. *Tui-na* massage harmonizes *Yin* and *Yang* along with balancing *Qi* and Blood flow by eliminating blockages associated with disease.[8] It is particularly well suited to treat OA from a TCVM perspective as it addresses and relieves *Qi*/Blood Stagnation in the body and keeps the energy moving through the Meridians.

The objective of this study was to evaluate the efficacy of an integrative treatment that combined TN with CM for treating canine patients suffering from OA. The hypothesis was that a combination of *Tui-na* manual therapy integrated with conventional medication would result in faster and more significant clinical improvement of dogs with osteoarthritis than treatment with conventional medication only without adverse side effects.

MATERIALS AND METHODS

The study subjects were client-owned dogs admitted to Acuvetpet (author's clinic) in Churchdown, Gloucestershire, in the United Kingdom. Inclusion criteria included dogs of any age and gender with (1) radiographic changes consistent with OA in bones and/or joints; (2) currently treated with CM; and (3) informed consent to participate provided by the owner. Exclusion criteria included (1) pain caused by other conditions such as neuromuscular pain, degenerative neuropathy, degenerative myelopathy; and (2) received treatments other than CM (e.g. acupuncture, laser-therapy, chiropractic, osteopathic treatment, massage).

Each subject was randomly assigned to the Treatment Group (CM+TN) or to the Control Group (CM). Randomization was executed through token-drawing from a bag containing an equal number of "treatment" (T) and "control" (C) tokens. Dogs in the Control Group received their usual CM treatment only whereas dogs in the Treatment Group received TN massage for 20 minutes weekly for five consecutive weeks in addition to their usual CM treatment. Conventional medications that study dogs continued during the clinical trial included NSAIDs, analgesics, gamma-aminobutyric acid (GABA)-receptor drugs or a combination of them.

The TN massage was performed by the author, who is a veterinary surgeon and certified *Tui-na* therapist. Each massage session used *Mo-fa*, *Rou-fa*, *Tui-fa*, *Cuo-fa* and *Ba-shen-fa* TN techniques (Table 1).[8] No other massage was performed during the trial by the owner or another therapist so that the outcomes of the study were not confounded. Objective blinded assessment was performed on range of motion (ROM) changes in the dogs (pre-treatment and study termination). Owners were not blinded to the treatment group their dog was allocated to. They performed objective assessments (number of walks each day and duration of each walk) as well as subjective assessments evaluating quality of life (QoL), pain and weakness (Table 2).

Table 1: *Tui-na* techniques used in the treatment arm of the study for dogs affected with osteoarthritis.

***Tui-na* Technique**	**Actions[8]**
Touching skin and muscle (*Mo-fa*)	Harmonizes the Middle *Jiao*, regulates the *Qi,* removes accumulation, and resolves Stagnation
Rotary kneading (*Rou-fa*)	Regulates the *Ying* and *Wei*, unblocks the *Qi* and Blood, extends the chest and regulates *Qi*, eliminates food retention, resolves swelling and relieves pain
Pushing (*Tui-fa*)	Relaxes the tendons, dissipates local Stagnation, excites the muscles, and improves circulation of Blood
Kneading (*Cuo-fa*)	Regulates the Channels, and invigorates *Qi* and Blood
Stretching (*Ba-shen-fa*)	Stretches the tendons, regulates the Channels

Table 2: Outcome data assessed and scoring in study dogs to determine changes in osteoarthritis over a 5-week treatment period.

Clinical Signs Evaluated	Scoring range	Evaluator
Pain: lameness, excess licking affected joints, crying, panting, reluctant to walk or not wanting to walk too far or too long, avoiding getting touched on affected joints	0 = no pain 10 = maximum pain	Owner
Weakness: joint strength, dragging affected limbs, lowered hindquarters, muscle atrophy, proprioceptive deficits, difficulties rising or sitting down	0 = very weak 10 = very strong	Owner
Frequency - Number of walks each day	Objective data	Owner
Duration of walks (total minutes per week)	Objective data	Owner
Quality of Life: OA effect on basics of eating, drinking, urinating and defecating, interacting with family members, interest in participating in family activities	0 = no QoL; 10 = excellent QoL	Owner
Range of Motion	0 = no joint movement 10 = normal joint flexion and extension	Two independent blinded assessors; Scores averaged

OA=osteoarthritis, Qol=quality of life

Table 3: Summary of Breeds that were part of the study.

Control Group	Treatment Group
Border Terrier	Labrador Retriever x Springer Spaniel
Standard Poodle	Labrador Retriever
Labrador Retriever	Springer Spaniel
Old English Bulldog	Labradoodle
Springer Spaniel	Flat Coated Retriever
Lurcher x Staffordshire Bull Terirer	Border Collie
Golden Retriever x Standard Poodle	Border Terrier
Labrador Retriever x Border Collie	Golden Retriever
Labrador Retriever x Staffordshire Bull Terrier	Bull Mastiff x Staffordshire Bull Terrier
Labrador Retriever x Springer Spaniel	Chesapeake Bay Retriever
Jack Russell Terrier	

The study tested the hypothesis that canine patients with OA treated with the combination of TN massage and CM have better treatment outcomes than those treated with CM only. Based on the quantitative measurements, the data analyses tested null and alternative statistical hypotheses. The null hypothesis (H_0) stated the combination of TN + CM results in the same ROM, QoL, weakness, walk frequency/duration and pain score improvement as CM alone for the treatment of dogs with OA. The alternative hypothesis (H_A) stated that the combination of TN + CM results in greater outcome data improvement than CM alone for the treatment of dogs with OA. As the hypotheses compared two independent subject groups with respect to quantitative outcome data (improvement of score), two-sample t or Wilcoxon Rank Sum tests were applied to test the hypothesis, depending on the distribution of the data under inference (normality test).

All tests were two-sided and the null hypothesis was rejected when the resulting *p*-value was less than 0.05. Sample size calculation for the study predicted enrollment of 47 dogs (n=23 or 24 per group), offered a power of over 90% for rejecting the null hypothesis with a 0.05 significance level when the group difference is at least 20% above the sample standard deviation. If Wilcoxon Rank Sum test was used, the test would have approximately 87% power to reject the null hypothesis

with a 0.05 significance level when the probability of a subject in the Treatment Group having more improvement than one in the Control Group was 80%. A commercial statistical software was used for all data graphic presentations and statistical analysis[a].

RESULTS

A total of 47 dogs admitted to the investigator's clinic met the inclusion/exclusion criteria and were enrolled in the study. The group randomization procedure resulted in 24 patients and 11 different breeds in the Control Group (receiving CM only) and the remaining 23 dogs representing 10 different breeds were placed in the Treatment Group (treated with CM + TN) (Table 3). All patients completed the 5-week study experimental treatments and all required assessments for data collection. There were no adverse effects in either study group during conduct of the study.

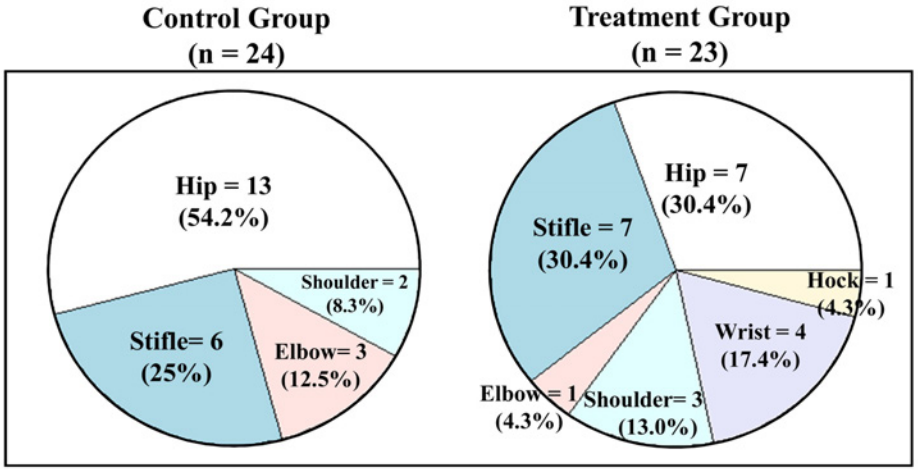

Figure 1: Distribution of OA affected joints in each study group. The two multinomial distributions were not significantly different at a 0.05 significance level ($p = 0.148$) based on Fisher's Exact test.

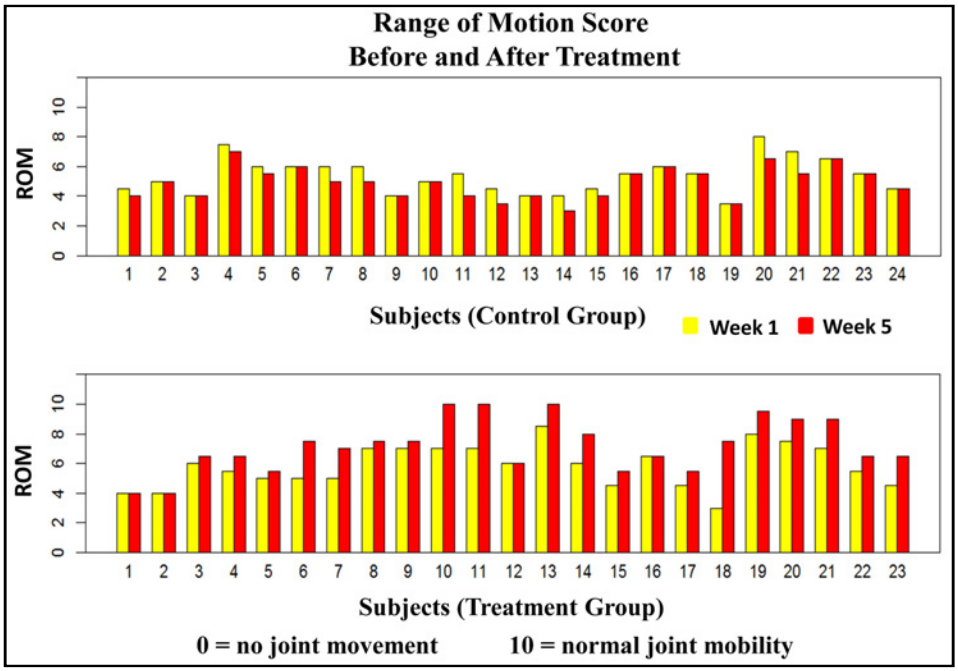

Figure 2: Range of motion (ROM) assessments in each individual subject; mean of two clinicians' ROM was used. Comparison between the two subject groups in terms of the improvement on the ROM suggests that the Treatment Group had significantly better improvement than the Control Group ($p = 1.48 \times 10^{-10}$).

The mean±SD age in the Control Group was 10.63±2.84 years old compared to 10.09±2.94 years old in the Treatment Group (p = 0.467, Wilcoxon Rank Sum test). Individual body weight in the Control Group was 27.46±9.72 kg compared to 26.07±9.91 kg in the Treatment Group (p = 0.608, Wilcoxon Rank Sum test). The distribution of sex in the Control Group was 79.2% (19/24) female vs. 20.8% (5/24) male with the female proportion significantly dominant (> 50%) in the group (p = 0.007, Binomial test). In the Treatment Group, 56.5% (13/23) were female and 43.5% (10/23) were male, which was more balanced (p = 0.678 by Binomial test). Between the two study groups, the proportions of female (or male) were not significantly different (p = 0.125, Fisher's Exact test).

The hip and stifle accounted for the greatest OA incidence in both control and treatment dogs with other joints such as shoulder, elbow, hock and carpus having smaller and more variable incidence (Figure 1). The two multinomial distributions were not, however, significantly different from each other at a 0.05 significance level (p = 0.148) based on Fisher's Exact test.

Range of Motion

For the study, ROM score, ranging from 0 (not able to move the affected joint) to 10 (normal and complete movement of the joint), was evaluated by two independent blinded assessors (veterinary clinicians) at Week 1 and Week 5 (Figure 2). The mean±SD ROM score at Week 1 in the Control Group was 5.35±1.17 and at Week 5 the mean dropped to 4.92±1.07. None of the control subjects' ROMs were improved: 13 unchanged (54.2%) and 11 worse (45.8%). The overall change within the group (mean±SD = -0.44±0.56) was statistically significant (p = 0.001).

In the Treatment Group, the Week 1 mean ROM was 5.83±1.42, which was not significantly different from that of the Control Group (p = 0.222). After 5 weeks of treatment, the mean ROM increased (improved) to 7.20±1.78, which was statistically significant (mean±SD = 1.37±1.15; $p = 3.82\times10^{-6}$). None of the subjects in the Treatment Group had reduced ROMs with 19 improved (82.6%) and 4 unchanged (17.4%). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.48\text{x}10^{-10}$) (Figure 3, Table 4).

Frequency and Duration of Walk

With more objective assessments, the owners also kept records on the frequency (number per day) and the duration (total minutes during the week) of walks in Week 1 and Week 5. During Week 1 in the Control Group, 10 subjects had 1 walk per day; 10 had 2 per day and 4 had 3 per day (mean±SD = 1.76±0.74; Table 4). After 5 weeks, 12 subjects had 1 walk per day; 11 had 2 per day; and 1 had 3 per day (mean±SD = 1.54±0.59). Nineteen subjects were unchanged and the remaining 5 reduced by 1. This change (-0.21±0.41) was not statistically significant (p = 0.063).

In the Treatment Group at Week 1, there were 13 subjects with 1 walk per day and the rest (10 dogs) had 2 per day (mean±SD = 1.43±0.51). At Week 5, 11 subjects had 1 walk per day and the rest (12 dogs) had 2 per day (mean±SD = 1.52±0.51). Twenty-one subjects were unchanged and the remaining 2 increased by 1 walk (mean±SD = 0.09±0.29; p = 0.500). Comparison between the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, p = 0.015).

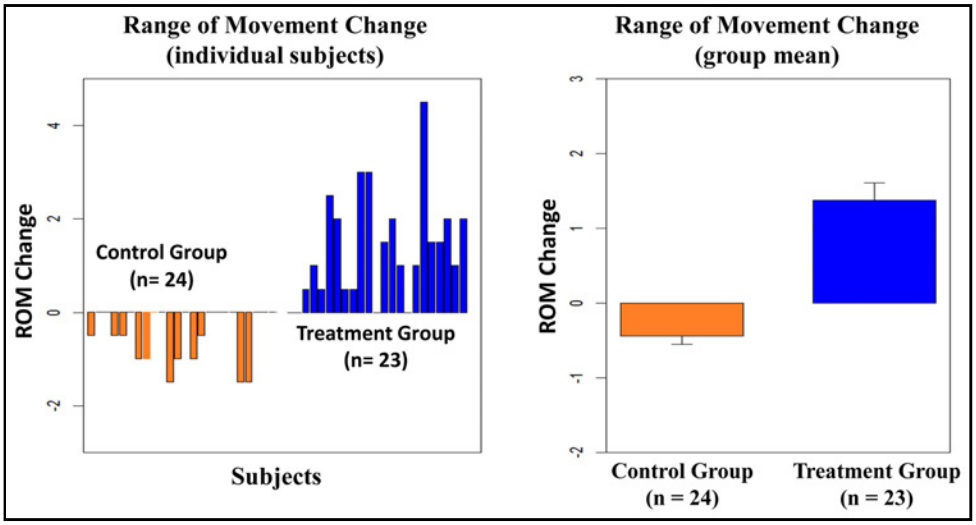

Figure 3: Changes in ROM assessment from Week 1 to Week 5 shows the change of ROM scores from Week 1 and Week 5 individually and within each group. None of the control subjects' ROMs were improved with 13 unchanged (54.2%) and 11 worsened (45.8%) with mean±SD = -0.44±0.56, p = 0.001. None of the subjects in the Treatment Group had reduced ROMs with 19 improved (82.6%) and 4 unchanged (17.4%) with mean±SD = 1.37±1.15; $p = 3.82\times10^{-6}$.

Table 4: Summary table of outcome data results. A decreased pain score equals improvement while all other scores are increased when showing improvement.

	Range of Motion (mean±SD)		Frequency Of Walks (mean±SD)		Duration Of Walks^ (mean±SD)		Quality of Life (mean±SD)		Pain Score (mean±SD)		Weakness Score (mean±SD)	
Control	Pre 5.35 ±1.17	Post 4.92 ±1.07	Pre 1.76 ±0.74	Post 1.54 ±0.59	Pre 49.6 ±29.4	Post 48.8 ±29.7	Pre 8.08 ±0.83	Post 7.75 ±1.29	Pre 4.18 ±1.37	Post 4.79 ±1.69	Pre 5.96 ±1.71	Post 5.54 ±2.06
Change (*p*-value)	-0.44±0.56 (0.001)		-0.21±0.41 (0.063)		-0.83±4.08 (1.00)		-0.33±0.76 (0.125)		0.63±0.92 (0.008)		-0.42±0.72 (0.016)	
Treated	5.83 ±1.42	7.20 ±1.78	1.43 ±0.51	1.52 ±0.51	52.8 ±25.9	68.3 ±31.6	7.26 ±1.14	8.21 ±1.31	4.17 ±1.40	2.48 ±1.83	5.57 ±1.88	7.39 ±1.70
Change (*p*-value)	1.37±1.15 (3.82×10^{-6})		0.09±0.29 (0.500)		15.4±17.0 (2.6×10^{-4})		0.96±0.82 (1.53×10^{-5})		-1.70±1.11 (3.82×10^{-6})		1.83±1.30 (7.63 ± 10^{-6})	
Tm vs Control Improved (*p*-value)	Tm > Control (1.48×10^{-10})**		Tm > Control (0.015)*		Tm > Control (2.75×10^{-5})**		Tm > Control (1.43×10^{-8})**		Tm > Control (3.01×10^{-10})**		Tm > Control (1.63×10^{-9})**	

* Treatment Group has statistically significant improvement when compared to Control Group, $p<0.05$
**Treatment Group has statistically significant improvement when compared to Control Group, $p<0.0001$
^ = minutes; Pre= pre-treatment, Post=post-treatment, Tm=treatment

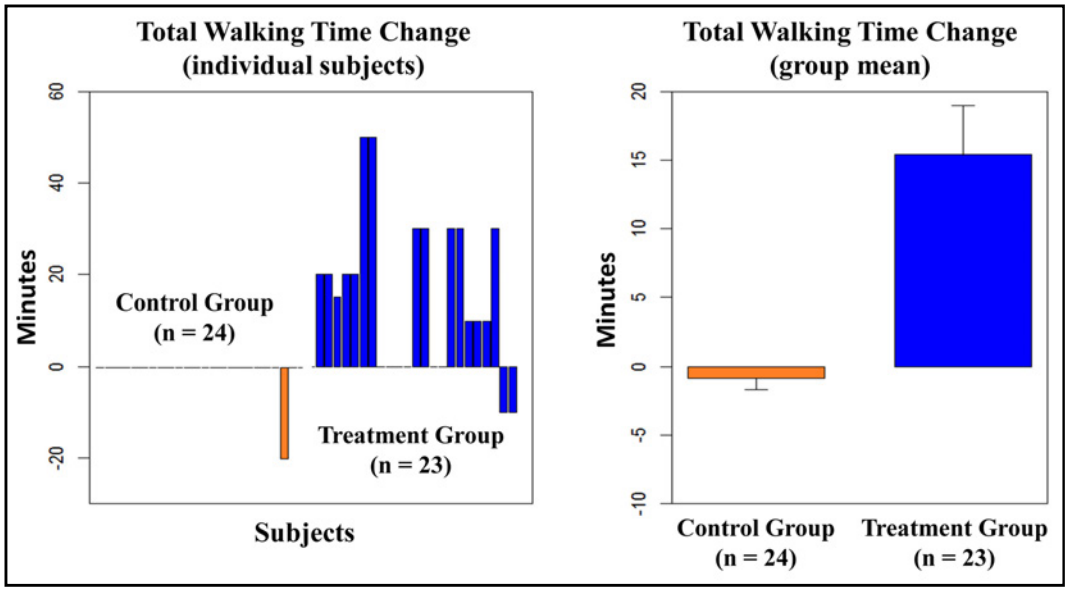

Figure 4: Changes in total walking duration from Week 1 to Week 5. Comparison of total walking time improvement between the two study groups demonstrated a statistically significant difference with the Treatment Group change (increased duration) greater than the Control Group ($p = 2.75\times10^{-5}$).

With respect to the total walking duration within the assessment week, the mean±SD total walking time during Week 1 in the Control Group was 49.6±29.4 minutes and during Week 5 the mean was slightly dropped to 48.8±29.7 minutes. Only 1 out of 24 (4.2%) subjects in the group had reduced total walking time and the time of the remaining subjects were unchanged. Overall, the change within the group (mean±SD = -0.83±4.08) was not statistically significant ($p = 1.00$).

In the Treatment Group, the Week 1 mean±SD total walking time was 52.8±25.9 minutes, which was not significantly different from that of the Control Group

(p = 0.552). After 5 weeks, the mean total walking time increased (improved) to 68.3±31.6 minutes, which was statistically significant (mean±SD = 15.4±17.0; $p = 2.6\text{x}10^{-4}$). Fifteen out of the 23 (65.2%) subjects in the Treatment Group had longer total walking time after 5 weeks; 6 (26.1%) remained unchanged, and the remaining 2 (8.7%) subjects had reduced total walking time. The group difference with respect to the change was statistically significant (Tm>Control, $p = 2.75\times10^{-5}$) (Table 4, Figure 4).

Quality of Life

Similarly, QoL of each subject was assessed by the owner via a QoL score with a range of 0 (no QoL) to 10 (excellent QoL) at the beginning (Week 1) and the end (Week 5) of the study (Figure 5). The mean±SD QoL score at Week 1 in the Control Group was 8.08±0.83 and at Week 5 the mean was slightly dropped to 7.75±1.29 (Table 4). There were 4 out of 24 (16.7%) subjects in the group that had QoL scores that became worse with the scores of the remaining subjects unchanged. Overall, the change within the group (mean±SD = -0.33±0.76) was not statistically significant (p = 0.125).

In the Treatment Group, the Week 1 mean QoL score was 7.26±1.14, which was significantly worse than the Control Group (p = 0.009). After 5 weeks, the mean QoL score increased (improved) to 8.21± 1.31), which was statistically significant (mean±SD = 0.96±0.82; $p = 1.53\times10^{-5}$). Seventeen out of the 23 (73.9%) subjects in this group had improved QoL scores with the remaining 6 subjects unchanged (Table 4, Figure 6). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.43\text{x}10^{-8}$).

Pain score

Each subject's pain level was assessed both pre-study (Week 1) and at study termination (Week 5) by the owner with scores ranging from 0 (no pain) to 10 (maximal pain) (Figure 7). The mean±SD pain score at Week 1 in the Control Group was 4.18±1.37 and at Week 5 was 4.79±1.69 (Table 4). The pain scores deteriorated (increased pain) in 8 of 24 (33.3%) subjects in the group while scores of the remaining subjects were unchanged. This worsening change within the group (mean±SD = 0.63±0.92) was statistically significant (p = 0.008).

In the Treatment Group, the Week 1 mean±SD pain score was 4.17±1.40, which was comparable to that of the Control Group (p = 0.968). After 5 weeks, the mean±SD pain score dropped (improved) to 2.48±1.83, which was statistically significant (mean±SD = -1.70±1.11; $p = 3.82\times10^{-6}$). Twenty out of the 23 (87.0%) subjects in this group had improved pain scores; the remaining 3 subjects had unchanged scores (Table 4, Figure 8). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 3.01\text{x}10^{-10}$).

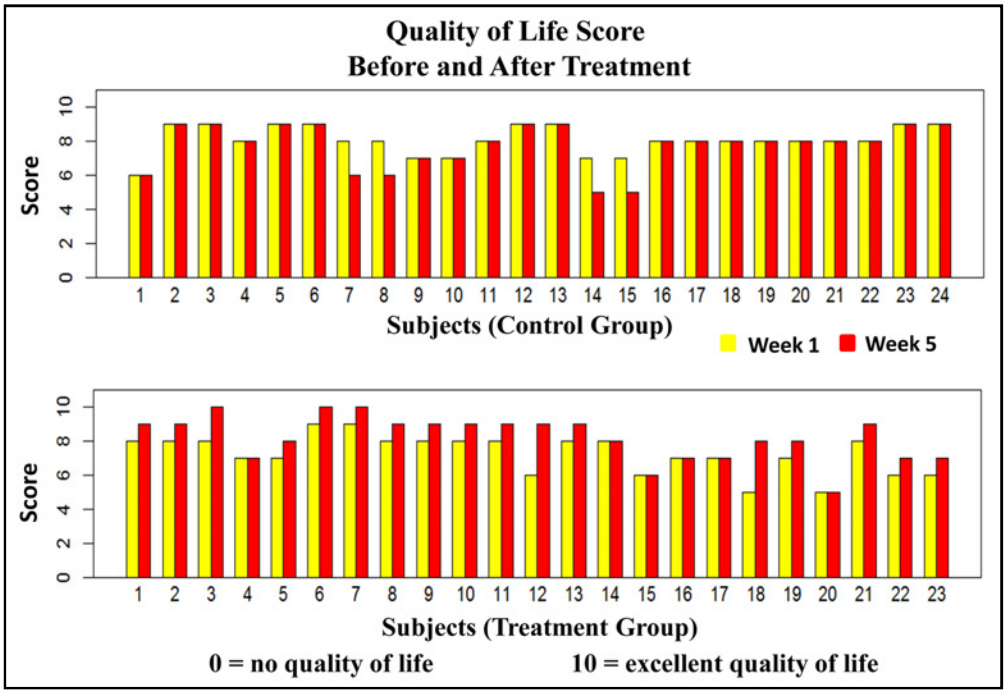

Figure 5: Quality of life scores in each individual subject. When comparing both study groups for QoL score improvement, the Treatment Group had statistically significant greater improvement ($p = 1.43\times10^{-8}$) than controls.

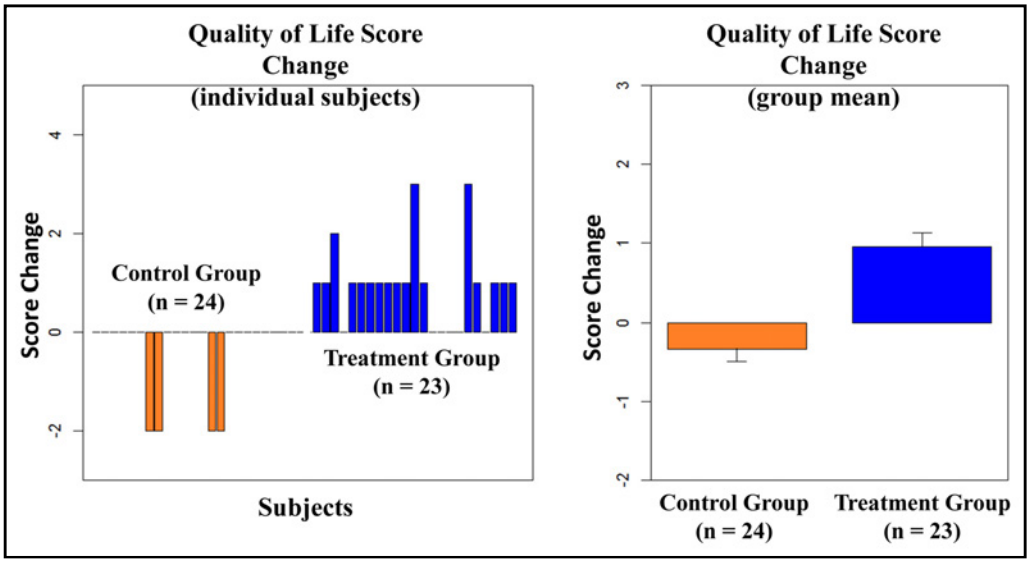

Figure 6: Changes in Quality of life (QoL) scores from Week 1 to Week 5. There were 4 out of 24 (16.7%) subjects in the Control Group that had QoL scores that became worse with the scores of the remaining subjects unchanged (mean±SD = -0.33±0.76, p = 0.125). Seventeen out of the 23 (73.9%) subjects in the Treatment Group had improved QoL scores with the remaining 6 subjects unchanged (mean±SD = 0.96±0.82; $p = 1.53\times10^{-5}$).

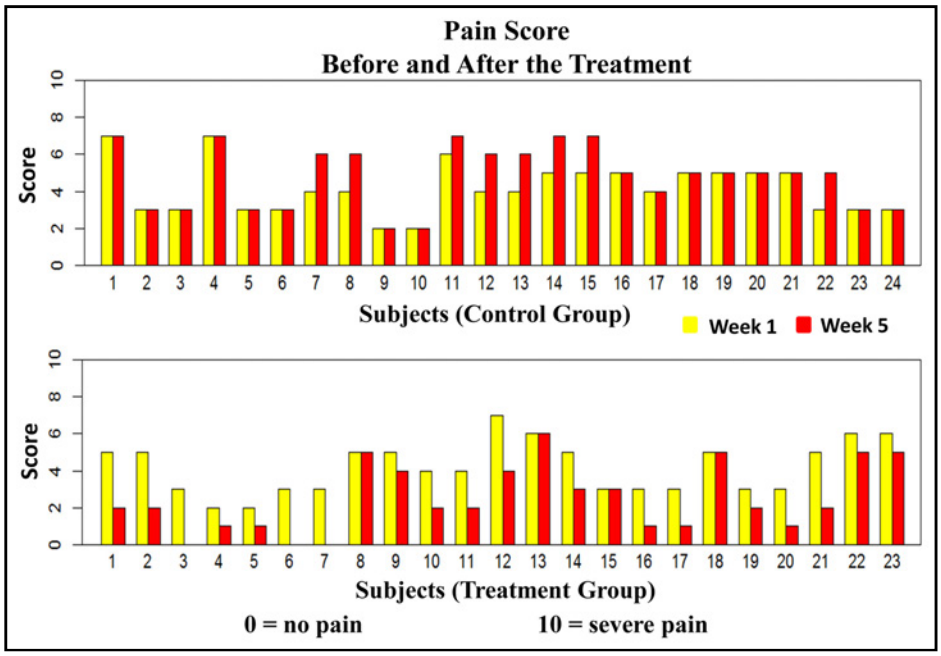

Figure 7: Pain scores in each individual subject (pre- and post-treatment). The Treatment Group had significantly better pain improvement when compared to the Control Group ($p = 3.01\times10^{-10}$).

Weakness Score

Joint strength was also assessed by the owner with a weakness score, ranging from 0 (very weak) to 10 (very strong), at Week 1 and Week 5 (Figure 9). The mean±SD weakness score at Week 1 in the Control Group was 5.96±1.71 and at Week 5 the mean dropped to 5.54±2.06 (Table 4). Seven out of 24 (29.2%) subjects in the group had weakness scores which were worse and the scores of the remaining subjects were unchanged. Overall, the change (weakening of the joints) within the group (mean±SD = -0.42±0.72) was statistically significant (p = 0.016).

In the Treatment Group, the Week 1 mean±SD weakness score was 5.57±1.88, which was comparable to that of the Control Group (p = 0.385). After 5 weeks, the mean weakness score increased (improved) to 7.39±1.70, which was statistically significant (mean±SD = 1.83±1.30; $p = 7.63\times10^{-6}$). Eighteen out of the 23 (78.3%) subjects in this group had improved weakness scores; the remaining 5 subjects had unchanged scores (Table 4, Figure 10). Comparison between improvement of the 2 groups demonstrated a statistically significant difference with respect to the change (Tm > Control, $p = 1.63\text{x}10^{-9}$).

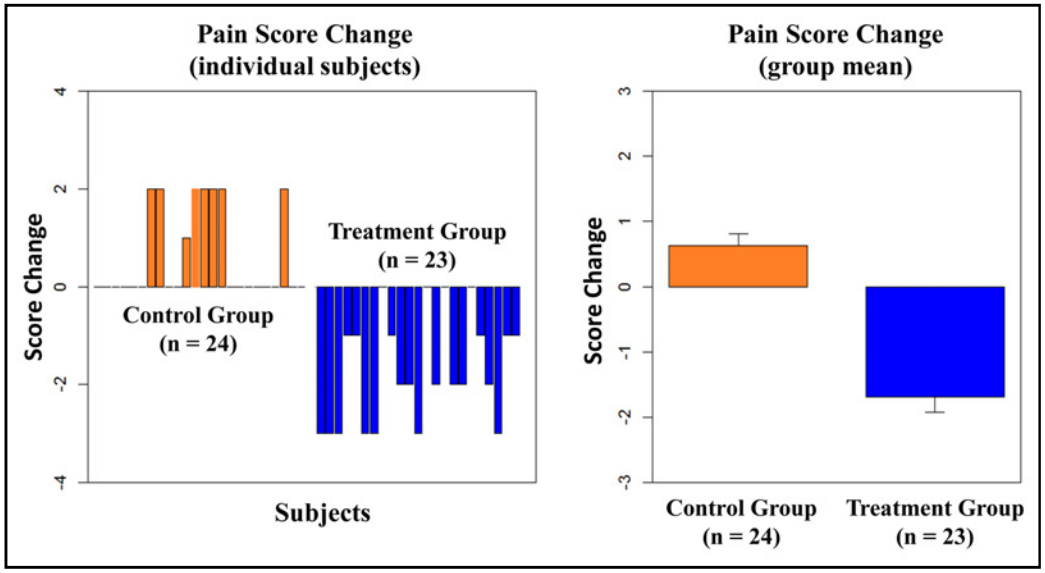

Figure 8: The pain score change (positive = worse; negative = improved) from Week 1 to Week 5 in each subject (left panel) and mean change in each study group (right panel) is demonstrated. There was an increased score in 8 of 24 (33.3%) subjects in the Control Group while scores of the remaining subjects were unchanged (mean±SD = 0.63±0.92, p = 0.008). Twenty out of the 23 (87.0%) subjects in the Treatment Group had decreased pain at Week 5; the remaining 3 subjects had unchanged scores (mean±SD = -1.70±1.11; $p = 3.82\times10^{-6}$).

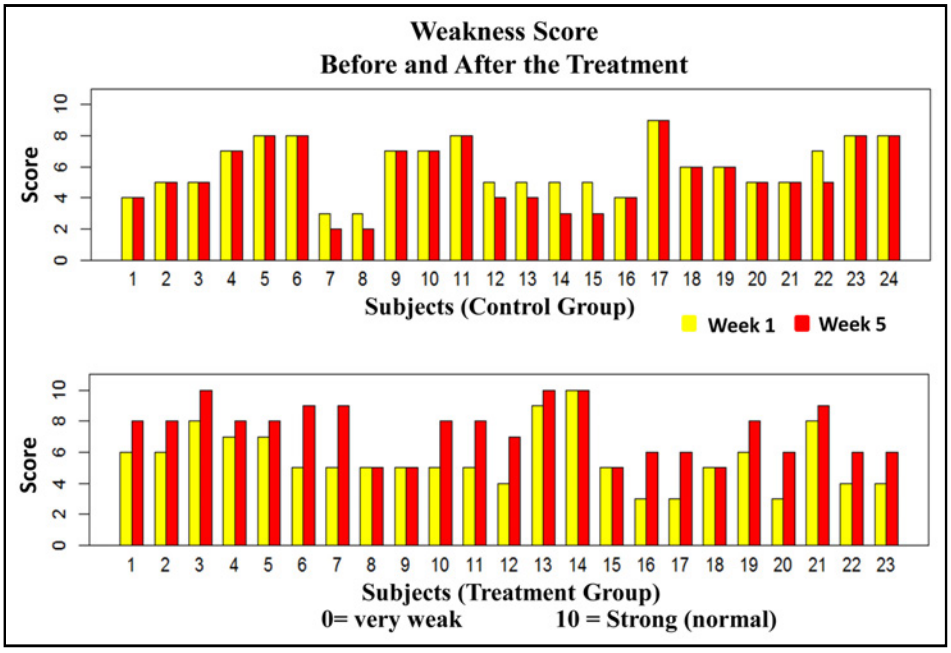

Figure 9: Weakness scores in each individual subject. Comparison between weakness score improvement between the two study groups demonstrated the Treatment Group had significantly better improvement than the Control Group ($p = 1.63\times10^{-9}$).

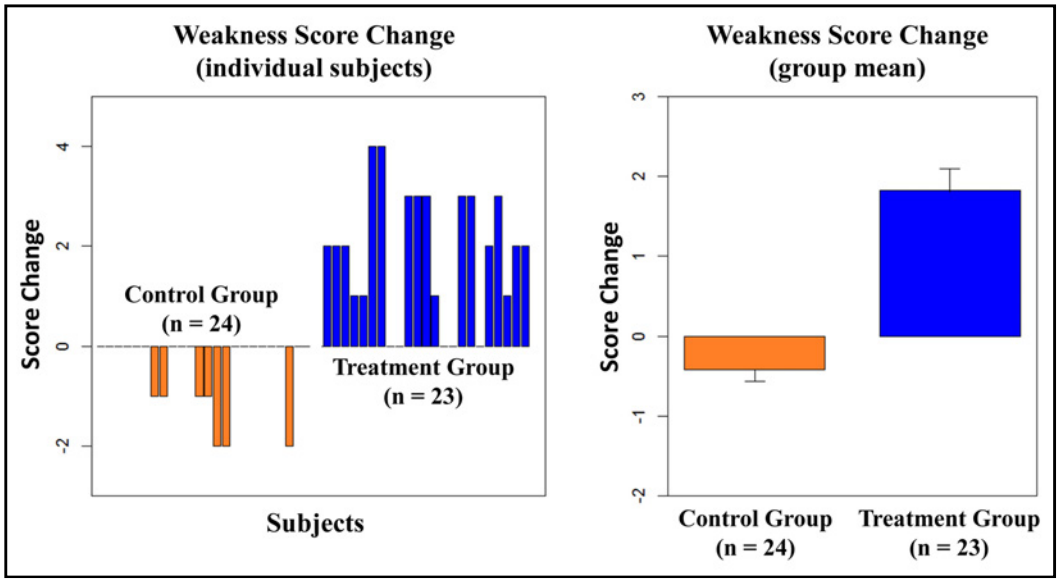

Figure 10: Changes in weakness scores from Week 1 to Week 5; there were 7 out of 24 (29.2%) subjects in the Control Group with increased weakness at study termination while the remaining subjects were unchanged (mean±SD = -0.42±0.72, $p = 0.016$). Eighteen out of the 23 (78.3%) subjects in the Treatment Group had improved weakness scores; the remaining 5 subjects had unchanged scores (mean±SD = 1.83±1.30, $p = 7.63\times10^{-6}$).

DISCUSSION

This randomized controlled clinical study investigated the effectiveness of using conventional therapy combined with *Tui-na* massage to treat canine osteoarthritis (OA). The results of the study demonstrated statistically significant improved joint mobility, increased activity level, less pain, improved strength and quality of life in the experimental group when compared to controls. These findings supported the hypothesis that integrative treatment combining *Tui-na* with conventional medicine constitutes a more effective treatment for canine OA patients when compared with conventional therapy alone without adverse side effects.

Comparison between groups after five weeks demonstrated significantly greater improvement for the Treatment Group when compared to the Control Group for all outcome data scores. Range of motion evaluation by 2 clinicians blinded to study group demonstrated significant improvement in the TN treated dogs with 82% improved versus controls which had 46% of the dogs showing deterioration of the ROM score and 54% unchanged ($p = 1.48\times10^{-10}$). Decreased pain occurred in 87% of treatment dogs versus increased pain in 33% of controls and the remainder unchanged ($p = 3.01\times10^{-10}$). Weakness improvement was similar with 78% of treated dogs showing greater strength while 29% of controls became weaker and the remaining dogs unchanged during the 5 week study period ($p = 1.63\times10^{-9}$). Quality of life followed a similar pattern with 73% of treated dogs with improved QoL compared to 13% of controls with worsening QoL parameters ($p = 1.43\times10^{-8}$).

Most study dogs had unchanged walking frequency (approximately 80% control and 90% treatment). All changes were within 1 walk per day, where 5 control subjects had fewer walks and 2 treatment subjects had more walks (not statistically significant for either group), however, a statistically significant difference was present when the 2 groups were compared ($p = 0.015$). Total walking time (duration) per week showed improvement in 65% of treated dogs while controls remained unchanged with 1 dog that had decreased duration ($p = 2.75\times10^{-5}$).

Additional weekly outcome data showed that patients in the Treatment Group usually started to show improvement after 2 weeks into the treatment. An unexpected finding during the study was that the improvement in treated dogs created a scenario of over-exercise during Week 4 which was associated with slight worsening of some parameters. The affected dogs, however, quickly recovered and showed improvement again in Week 5. One other observation was the greater benefit observed for massage of the shoulders, elbows, hips and stifles when compared to treatment of arthritic carpal joints and hocks. This is similar to observations by other clinicians. In general, the dogs on CM only were stable during the study (unchanged) or mild decreases in individuals, however, the combination of CM with TN massage offered statistically significant better OA treatment success.

Tui-na massage as a manual therapy is an excellent technique to add to the multimodal treatment of OA in dogs, as well as in cats, rabbits, horses and cattle. When applying these manual therapy techniques, one can use hands or other parts of the body such as the elbows, knees, feet or objects as tools. It is low cost, does not

require special equipment and has the side benefits of improving patient-healer bond as well as providing an alternate but effective therapy for individuals that are needle shy. For anxious or restless patients, TN can be a good start for treatment which is then followed by acupuncture. The use of TN readily combines with other TCVM modalities as well as can include the patient's caregiver in their pet's treatment by giving a few easy TN techniques for them to perform daily on their pets.

From the TCVM perspective, selection of *Tui-na* protocols will follow TCVM patterns of disease.[8] The *Zang-fu* organ, Kidney, is associated with bone, therefore, patterns of OA will include Kidney *Qi* Deficiency, Kidney *Yin* Deficiency and combination patterns: Kidney *Qi* and *Yin* Deficiency, Kidney *Qi* and *Yang* Deficiency, Kidney *Qi*, *Yin* and *Yang* Deficiency.[7] As old age progresses, the Kidney becomes deficient in *Qi*. This *Qi* Deficiency Pattern causes the abnormal growth and degradation of bone in the joint area and sometimes neurological deficits as well. A *Yin* Deficiency Pattern is diagnosed when symptoms of general Heat and dryness are observed, whereas, a *Yang* Deficiency Pattern is diagnosed when symptoms of general Cold are present.[7] Also involved in OA is the Liver which usually presents as a Blood Deficiency or the lack of nourishment of tendons and ligaments that compose the affected joint. In some cases, the Spleen may be involved with the most common TCVM pattern related to OA as a *Qi* Deficiency associated with muscle atrophy and weakness or lack of strength.

Regarding manual therapy for the treatment of OA, other authors have come to similar conclusions and findings as the present study. In a human clinical trial investigating knee OA, the combination of exercise and massage therapy showed greater benefit at 9 weeks than exercise alone, however, to maintain benefits at 1 year, booster sessions were important.[9] Another human clinical study which was set up as a randomized controlled trial with assessor blinding compared treatment of hip OA with manual therapy or exercise therapy. Both groups participated in 25-minute sessions twice a week for nine weeks. Outcomes (improved, stable, worse) were assessed at 5, 17 and 29 weeks by multiple assessments including quality of life. Study findings demonstrated manual therapy had greater improvement of hip OA than exercise therapy.[10] In a systematic review, exercise alone, strength training alone and a combination of exercise and manual mobilization were compared for treatment of knee OA in humans. Study findings showed exercise plus manual manipulation demonstrated a moderate effect for pain relief versus only a small effect for the other 2 groups. The authors recommended therapists should consider adding manual mobilization to achieve better pain relief in OA patients.[11]

In veterinary patients, a clinical trial concluded that the beneficial effects of massage therapy, both physically and psychologically, for small animals is equal to humans.[12] The benefits included improvement of muscle contractures and spams, flexibility, range of motion, performance, pain, stress, anxiety and quality of life. This study used human massage techniques that can be extrapolated to small animals including effleurage, kneading, petrissage, friction, tapotage, vibration and shaking.[12] A similar conclusion on the use of manual therapy in animals was presented by another author who supported a multimodal approach to the treatment of osteoarthritis. Physiological and anatomical similarities between dogs, cats and humans was pointed out which makes the discoveries in humans related to massage applicable to these animals.[7] The massage techniques recommended were similar to the previous author and included stroking, effleurage, compression, kneading and wringing, friction and percussion.[13] All of these techniques have a correspondence in TN massage, with TN offering the additional benefit of an individualized treatment protocol based on TCVM pattern diagnosis.

Clinical research has provided insights into potential underlying mechanisms for reduction of pain associated with massage. The mechanism most frequently cited is the Gate Control Theory.[14] Pain stimulates shorter less myelinated nerve fibers which take longer to reach the brain than massage associated pressure signals which are carried by longer faster myelinated fibers which "close the gate" before the pain response arrives.[14] Additionally, massage increases production of the anti-pain neurotransmitter, serotonin, which is associated with decreased levels of substance P (increases pain perception and inflammation).[15,16]

Other benefits of massage's mechanical pressure appear to be increased blood flow to affected areas by increasing the arteriolar pressure and increasing muscle temperature from rubbing.[14] Depending on the massage technique, mechanical pressure on the muscle is expected to increase or decrease neural excitability.[17] A reduction in the stretch reflex would be desirable because spinal hyperexcitability is associated with chronic pain syndromes.[18] More widespread systemic effects include stimulation of pressure receptors which enhance vagal activity and produce changes in parasympathetic activity. This includes lower heart rate and blood pressure and measurably lower levels of cortisol. One study pointed out massage appeared to be more effective than anti-hypertensive drugs in lowering systolic and diastolic blood pressure.[19] Finally there have been some interesting studies documenting immunomodulation with lower production of cytokines (pro-inflammatory cells associated with Th2) which would benefit the inflamed joints associated with OA.[14]

Limitations in this study included potential bias of unblinded owners evaluating parameters such as pain, weakness and quality of life. Objective measures were also used which yielded similar statistically significant findings. These included range of motion evaluated by blinded veterinary evaluators and owner objective measures such as frequency and duration of daily walks. The range of motion scoring measurements (0-10) would be improved by using angle calipers with the aid of a trained assistant. Study quality would also benefit from

including post-study measurements at week 2, 4, 6 and 8 for measurement of length of residual massage effects. Some studies have suggested post-treatment benefits of up to 2 months following cessation of massage.[14] Finally, outcome variation could be mitigated (thus enhance the study power) by reducing the number of joints included in the study (e.g. shoulders, elbows, hips, stifles only).

In summary, the present study found that dogs undergoing five weekly TN treatment sessions integrated into their usual treatment for osteoarthritis had decreased pain, improved activity levels, more strength in affected limbs and improvement in the ROM and QoL. These effects were seen as early as 2 weeks after study start. Based on study findings, the combination of CM with TN massage can offer better opportunities of success in the treatment of these patients than treatment with CM alone and is recommended as a beneficial adjunct to conventional treatments for canine osteoarthritis.

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FOOTNOTES

a. R version 3.5.2; 2018-12-20, The R Foundation for Statistical Computing, Vienna Austria; http://www.R-project.org

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