Comparison of the Efficacy of Conventional Medical Management of Canine Stifle Joint Pain with an Integrative Medical Approach

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ABSTRACT

An increasing number of veterinarians are offering acupuncture treatments as a pain management strategy for dogs with stifle joint related pain. The current study investigated the efficacy of an integrative medical approach by adding traditional Chinese veterinary medicine (TCVM) to conventional treatment protocols for canine joint pain. A total of 19 dogs meeting the inclusion criteria of at least 2 years of age and pain localized to one or both stifle joints were enrolled. Subjects were divided in a non-randomized manner into a Control Group (conventional medical treatment, n=7) and Test Group (TCVM + conventional treatment, n=12). The Control Group received pain relief medications along with rehabilitation exercises, whereas the Test Group received acupuncture and Chinese herbal medicine prescriptions, in addition to their conventional treatments. Outcome measurements included a blinded assessment (computerized weight bearing stance analysis mat) and non-blinded assessments (lameness grading, goniometric measurements of affected stifle, thigh circumference). The study found that the Test Group had significant improvements after integrative treatment in each of the 7 measurements assessed ($p<0.05$), whereas the Control Group showed significant improvements of 2 measurements (overall lameness, stifle extension, $p<0.05$). Group comparisons demonstrated a statistically significant greater effect for walking and overall lameness in the Test Group. The results suggest that integrating the proposed TCVM treatment with conventional medical management can increase the efficacy of stifle joint pain relief in dogs. Future studies with randomization, blinding, and a larger sample size are warranted.

Key words: integrative medicine, acupuncture, Chinese herbal medicine, canine, stifle, joint pain, osteoarthritis

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ABBREVIATIONS

CCL	Cranial cruciate ligament
NSAID	Nonsteroidal anti-inflammatory drug
ROM	Range of motion
TCM	Traditional Chinese medicine
TCVM	Traditional Chinese veterinary medicine

Osteoarthritis is a common condition affecting a large population of dogs. Estimates from North America report age specific prevalence values ranging from 20% in dogs older than one year up to 80% in dogs older than eight years, based on radiographic and clinical data from referral settings.[1] The disease is characterized by inflammation, pain, cartilage degradation, osteophyte formation and bone remodeling. The stifle is particularly vulnerable to osteoarthritis secondary to cruciate ligament injuries due to joint instability. It is one of the most common causes of lameness and pain in dogs and has a reported prevalence as a cause of lameness at 32% with 29% incidence left limbs, 28% in right limbs and 43% occurring bilateral.[2] As osteoarthritis cannot be cured, in some cases unlike acute pain, the resulting chronic pain can persist even in the absence of inflammation making it refractory to conventional anti-inflammatory treatments.[3] Treatments, therefore, are directed at slowing the clinical progression in degenerative cases and pain management in all cases with the goal of improving patient quality of life.

Primary pain management for canine joint pain and arthritis currently includes a variety of nonsteroidal anti-inflammatory drugs (NSAIDs). One study showed that mavacoxib and carprofen were effective at reducing pain level with 93.4% of the mavacoxib dogs improving and 89.1% of the carprofen dogs showing improvement.[4] As patients with chronic pain (maladaptive or neuropathic) do not respond to the administration of NSAIDs alone, layering another medication that specifically targets neuropathic pain is a strategy employed by veterinary clinicians. Using this strategy, it was demonstrated in a

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study that the addition of amantadine to an NSAID regimen demonstrated improvement in management of chronic arthritic pain.[5] Despite the usefulness of NSAIDs and pain modifying analgesic drugs, the use of many of these medications is contraindicated in patients with elevated hepatic and renal enzymes as commonly seen in geriatric dogs. Additionally, some patients will develop gastrointestinal inflammation/ulceration when given NSAIDs. For these reasons, often times veterinarians are left with few options to mitigate arthritis related pain.

According to traditional Chinese veterinary medicine (TCVM), one of the possible causes of disease is disruption of normal *Qi* flow.[6] Obstruction to the normal circulation of *Qi* (in the Meridians) or Blood (in the blood vessels) is considered the root cause of pain. This painful *Qi* obstruction of the Meridians is known as *Bi* Syndrome (as *Bi* means obstruction) and is the syndrome associated with the conventional medical diagnosis of osteoarthritis.[6,7] *Bi* Syndrome can be caused by either Excess or Deficiency patterns. Excess Patterns are caused by external pathogenic invasion and are therefore Wind *Bi* Syndrome, Cold *Bi* Syndrome, Damp *Bi* Syndrome and Heat *Bi* Syndrome. More chronic *Bi* Syndromes are characterized mainly by Deficiency. Damage and malformations of the bones develop and so these are known as Bony *Bi*. Deficiency patterns causing Bony *Bi* are Kidney *Qi* Deficiency, Kidney *Yang* Deficiency and Kidney *Yin* Deficiency.

The basic goals of TCVM are to expel pathogens, tonify deficiencies and/or relieve Stagnation, thus mitigating the pain associated with joint disease and osteoarthritis. By identifying the particular pattern of *Bi* Syndrome in an individual patient, more specific acupuncture points and herbal prescriptions can be administered, resulting in more effective treatment. Despite the increased clinical use of TCVM management of stifle joint pain and osteoarthritis related pain in companion animals, few evidence-based research studies exist investigating the efficacy of acupuncture or its use combined with Chinese herbal medicine in dogs. The objective of this controlled clinical study in naturally occurring canine stifle joint degenerative disease and arthritis was to evaluate the efficacy of adding both acupuncture and Chinese herbal medicine based on TCVM Patterns to current pain relief management. The study hypothesized that the integrative treatment of conventional medicine and TCVM treatment (acupuncture, Chinese herbal medicine) would result in more significant pain relief without side effects than in dogs with conventional medical management.

MATERIALS AND METHODS

Dogs referred to the investigator's clinic (Integrative Veterinary Wellness, Richardson, TX, USA) for arthritis pain management by their primary veterinarians were recruited for the study. Inclusion criteria included: (1) at least 2 years of age, (2) pain localized to one or both stifle joints, and (3) owner informed consent to participate. Subjects in the study were selected for the comorbidity of a cruciate injury or a suspected cruciate injury. Individuals with this condition have been shown in previous studies to have a synovitis which has rapid sequela of osteoarthritis due to the joint instability created by cranial cruciate ligament disruption. Increased incidence of contralateral stifle osteoarthritis has also been documented in comparison to dogs without cranial cruciate ligament disease.[8] Exclusion from the study in this patient population included: (1) known cardiovascular or respiratory issues that would limit an animal from participating in the rehabilitation protocol, (2) concurrent severe organ dysfunction such as renal or hepatic disease, and (3) marked aggression or behavioral issues that would make a study dog unsuitable to participate in the rehabilitation protocol or acupuncture treatments. Minor pain in another area of the body did not exclude enrollment of a dog.

Once informed consent was received from owners for dog participation, subjects were placed in either the Control Group or the Test Group in a non-randomized order based on owner desired treatment approach. Dogs in the Control Group only received conventional treatment, including any medications prescribed by their primary veterinarian and rehabilitation protocol provided by the investigator's clinic. Those in the Test Group also received conventional medical treatment by their primary veterinarian, the same rehabilitation protocol and had acupuncture and appropriate Chinese herbal medicine added to their treatment regimen. All study dogs underwent an intake examination on Study Day 1. This included computer stance mat analysis (performed by blinded technician) and lameness grading at walk and trot, range of motion measurements on both stifles and thigh circumference measurements (performed by primary investigator).

Patients in the Control Group began in-clinic rehabilitation following this exam. Protocol for rehabilitation for all study dogs lasted 30 minutes. This was divided between dry land exercises[a] (sit to stand, balance disc plank, cavalleti rails, weave poles) and underwater treadmill with time greater for dry land exercises at study start to time greater for underwater treadmill as animal improved (added in 1-2 minute increments). They completed this protocol twice weekly for 4 weeks. Patients in the Test Group had a thorough TCVM examination added to the lameness and stance analysis on Study Day 1. After a TCVM Pattern was assigned, each patient had their first acupuncture session, followed by identical underwater treadmill/dry land exercises. An appropriate Chinese herbal medicine formula was prescribed at a dose of 0.5g/10lbs of body weight. Instructions were given for oral administration twice daily and to begin the medication that evening. Similar to the Control Group, the test dogs completed the rehabilitation twice weekly for 4 weeks. Acupuncture treatments occurred on Study Day 1, 7, 14, and 21.

Acupuncture sessions were conducted by a certified veterinary acupuncturist (JS). The Test Group received acupuncture treatment with standardized needles[b]:

0.20·13mm/36g 0.5" (all acupoints for <20# dogs; limbs 20-50# dogs), 0.22·13mm/34g 0.5" (limbs >50#dogs; back+dorsal midline for 20-50# dogs) and 0.25·25mm/32g 1.0" (back+dorsal midline >50# dogs) were used for acupuncture point stimulation. Stimulation of acupoints was performed with the aid of an electrostimulatory device[c] for 20 minutes with a lead connected from BL-23 (Back-*shu* point for Kidney) to ST-36 (local point for the stifle) at a frequency of 20Hz. Dry needle acupuncture stimulation was performed on: BL-11 (influential point for bone), GB-34 (influential point for ligaments/tendons), BL-17 (influential point for Blood), BL-18 (Back-*shu* point for Liver), BL-19 (Back-*shu* point for Gall Bladder) and *Bai-hui* (to tonify *Yang*). Needles were inserted in all acupoints bilaterally with the exception of *Bai-hui* which is located on the midline.

Based on the TCVM Pattern, each patient also received acupuncture at the following additional acupoints: Damp (Fixed) *Bi* Syndrome: SP-6 (clears Damp), SP-9 (clears Damp); *Qi* Stagnation: ST-35 (stifle, rear limb weakness), BL-40 (Lower *He-sea* point for Bladder); *Bi* Syndrome due to Kidney *Yin* Deficiency and Kidney *Yin/Qi* Deficiency: BL-40 (Lower *He-sea* point for Bladder), KID-3 (*Yuan*-source point for Kidney); *Bi* Syndrome due to Kidney *Yang* Deficiency and Kidney *Yang/Qi* Deficiency: BL-40 (Lower *He-sea* point for Bladder), GV-3 (tonify Kidney *Yang*), GV-4 (tonify Kidney *Yang*).

Chinese herbal medicine formulations[d] prescribed in the study included *Di Gu Pi San* for *Bi* Syndrome due to Kidney *Yin* Deficiency and Kidney *Yin/Qi* Deficiency; Coix Formula for Fixed *Bi* Syndrome; Loranthus Formula or Dok's Formula for *Bi* Syndrome due to Kidney *Yang* Deficiency; Body Sore for *Qi* Stagnation and Tendon/Ligament Formula for Liver *Yin*/Blood Deficiency.[9]

There were 7 outcome measurements that were used for evaluation of study dog response to treatment. The first measurement, performed by the same person for all study dogs without knowledge of study group, was the measurement of static weight bearing forces on the affected stifle. This was evaluated using a computerized stance analyzer[e] (Figure 1). The other 6 measurements which were performed by the primary investigator included lameness grading at a walk, trot, overall lameness (walk + trot), range of motion (ROM) measurements (extension and flexion) on affected stifle and thigh circumference.

Scores with definitive criteria were used to decrease bias when assessing lameness. They were assigned for walking/trotting between 0 and 5 as follows: 0 = walking/trotting normally; 1 = slight lameness; 2 = obvious weight-bearing lameness; 3 = severe weight-bearing lameness; 4 = intermittent non-weight-bearing lameness; and 5 = continuous non-weight-bearing lameness.

The range of motion (ROM) of the stifle joints was measured with the dog in lateral recumbency using a goniometer[f]. The joint was slowly flexed until the first indication of discomfort was observed and the joint angle was recorded. Then, the joint was slowly extended until the first indication of discomfort was noted. This joint angle was recorded. The dog was then placed in lateral recumbency on the other side and the procedure was repeated for the other limb.

Figure 1: Picture of a dog standing on the computerized stance analyzer mat. The percentage of a patient's body weight placed on each limb while standing on the mat is analyzed with normal weight distribution for each front limb 30% and hind limb 20%.

Limb circumference is an indirect method of assessing changes in muscle mass. A measuring tape with a spring tension device[g] was used to ensure consistent tension on the tape when measurements were taken to decrease variability/bias for this measurement. Circumference was taken at 70% of the distance from the tip of the greater trochanter to the lateral fabella on each rear limb when the dog was standing. The change (Day 1 to Day 28) of each of the above measurements was calculated and used to compare the treatment outcome between the control and test groups.

To test the hypotheses that compare the improvement (numerical outcome measurement) between two independent treatment groups, the non-parametric Wilcoxon Rank Sum test was used. All tests were two-sided and a null hypothesis was rejected when the resulting *p*-value was less than 0.05. It was estimated that if the study enrolled a total of 19 subjects (12 Test Group, 7 Control Group); assuming an 85% probability that the test subject has more improvement than a control, such sample size would provide the statistical test with approximately 79% power.[10] All statistical analyses were performed using a commercial statistical software[h].

RESULTS

Nineteen dogs (7 Control Group, 12 Test Group) completed the study. Three dogs (43%) in the Control Group were females while 6 out of the 12 dogs (50%) in the Test Group were females (no significant difference, p=1.0). The mean±SD for age of the Control Group was 9.3±4.1 years old and 8.5±2.7 years old in the Test Group (no significant difference, p=0.885). The mean for study dog body weight in the Control Group was 21.6±12.5 kg and 22.7±12.4 kg in the Test Group (no significant difference, p=0.773). The outcome from the comparisons of signalment data suggested that the two subject groups were comparable and suitable for treatment outcomes comparison (Table 1).

All study dogs were able to complete the rehabilitation protocol and by study completion were usually 15 minutes of dry land exercises and were at least 12 minutes for underwater treadmill. NSAIDs were administered to 57% (4/7) of controls and 41% of test dogs (Table 2). All study dogs were monitored for adverse effects which included administration of the NSAIDs, Chinese herbal medicine formulas, acupuncture, and physical therapy (rehabilitation exercises). There were no adverse effects noted associated with control or test treatments in any dog during the course of this clinical study.

The percentage of a patient's body weight placed on the affected limb while standing was analyzed by a computerized stance analyzer with normal weight distribution for each front limb 30% and hind limb 20%. Company recommendations for use of the mat have a greater than 8.5 kg body weight requirement for accurate calibration. Two subjects, one from the Test Group (T-10) and one from the Control Group (C-7), were under this weight criterion and did not get measured. On the affected limb, the mean±SD stance percentage in the Test Group prior to treatment was 8.9±4.0% (median=9%) and was increased to 15.5±7.4% (median=12%) following treatment. The mean±SD improvement of 6.5±8.1% (median=3%) in stance percentage on the affected limb for the Test Group participants was statistically significant (p=0.03). The mean stance percentage on the affected limb for the Control Group prior to treatment was 9.3±4.3% (median=10%) and was 11±5.1% (median=10.5%) after treatment. The mean change of 1.7±3.1% (median=1.5%) was not statistically significant (p=0.31). Prior to treatment, the difference in the stance percentages between the two groups was not significant (p=0.61). Following treatment, the Test Group had a 73% improvement versus an 18.3% Control Group improvement when compared to baseline, however, the difference for improvement of weight bearing by the affected limb did not attain statistical significance (p=0.19) between the two groups (Table 3, Figure 2).

The mean±SD lameness score for walk in the Test Group prior to treatment was 3.3±1.35 and was 1.5±0.53 following the treatment protocol. One Test Group subject (T-06) was not included in the analysis as the walk lameness score prior to treatment was 0. Based on the Wilcoxon Signed Rank test, the mean walk lameness score improvement of the Test Group (1.91±1.14) was statistically significant (p=0.003). In the Control Group, the mean walking lameness score prior to treatment was 3.0±1.73 and was 2.29±1.50 following the treatment period. Based on the Wilcoxon Signed Rank Test, the walk score improvement of the Control Group (0.71±0.76) was not statistically significant (p=0.125). Prior to treatment, the difference in the walk lameness grade between groups was not significant (p=0.806). Comparison after treatment demonstrated significantly greater change (decreased score) in the Test Group when compared to the Control Group (p=0.016), based on the Wilcoxon Rank Sum Test (Table 3).

Table 1: Summary statistics on subject's characteristic data.

	Control (n = 7)	Test (n = 12)	*p*-value
Sex (Female %)	44%	50%	1.00
Age (mean±SD; years)	9.3 ± 4.1	8.5 ± 2.7	0.885
Weight (mean±SD; kg)	21.6 ± 12.5	22.7 ± 12.4	0.773

The mean±SD lameness score (trot) in the Test Group prior to treatment was 3.4±1.24 and was 1.75±0.87 following the treatment protocol. Based on the Wilcoxon Signed Rank Test, the Test Group improvement in trot lameness grade (mean±SD=1.67±0.78; median=2) was statistically significant (p=0.001). The Control Group's mean±SD trotting lameness score prior to treatment was 3.6±1.27 (median=4) and 2.6±1.51 (median=2.6) after the treatment period. The improvement in the Control Group's mean lameness trot grade (mean±SD=1.0±0.82; median=1) was not statistically significant (p=0.063). The group differences in both the baseline trot lameness grade and the post-treatment improvement, respectively, were not significant (p=0.808 and p=0.105, respectively) based on the Wilcoxon Rank Sum Test (Table 3).

In the Test Group when walk and trot lameness scores were combined to produce overall pre-treatment and post-treatment lameness scores (6.42±2.81, median=7 and 3.0±1.54, median=3; respectively) the mean improvement (3.42±1.93; median=4) was statistically significant (p=0.001). The Control Group pre-treatment and post-treatment mean lameness grades (6.57±2.99, median=7 and 4.86±2.91, median=5; respectively) also demonstrated mean improvement (1.71±1.25, median=1) with statistical significance (p=0.03). When comparing the 2 groups, the difference in pre-treatment overall lameness grade was not significant (p=0.91) but the post-treatment improvement in the Test Group was significantly greater than the Control Group (p=0.03).

The degree of stifle extension of the affected limb (normal extension considered 162°) was recorded for each subject before and after the assigned treatment. The mean±SD extension in the Test Group prior to treatment was 134±7.14° (median=132) and was 148.4±5.21° (med=148) following the treatment. The improvement (mean±SD=14.4±6.95°, median 12) was statistically significant (p=0.0005) based on the Wilcoxon Signed Rank Test. In the Control Group, the mean±SD degree of stifle extension prior to treatment was 138±12.96° (median=140) and was 146.9±8.23° (median=150) following the treatment. The improvement (mean±SD=8.86±5.98°, median 8) was statistically significant (p=0.02) based on the Wilcoxon Signed Rank Test. Prior to treatment, the difference in the degree of extension between the two groups was not significant (p=0.12). Following treatment, the Test Group had a 10.7% improvement versus an 6.4% Control Group improvement when compared to baseline, however, the difference in improvement between the two groups was not statistically significant (p=0.06) based on the Wilcoxon Rank Sum Test (Table 3).

The mean±SD degree of stifle flexion (normal flexion considered 45°) in the Test Group prior to treatment was 58.8±10.0° (median=57.5) and was 50.8±4.65° (median=49) following treatment. This change (mean±SD=8.0±10.5°, median=6.5) was statistically significant (p=0.03). For the Control Group, before treatment was 54.0±9.0° (median=50) and was 54.3±9.7° (median=50) after the treatment. The change in degrees of flexion of the affected limb for the Control Group (mean±SD=-0.3±4.8°) was not statistically significant (p=0.81). Prior to treatment, the difference in flexion degrees of the two treatment groups was not significant (p=0.29). Following treatment, the Test Group had a 13.6% improvement versus an 0.5% Control Group improvement when compared to baseline, however, the difference in improvement between the two groups was not statistically significant (p=0.10) based on the Wilcoxon Rank Sum Test (Table 3).

Table 2: Summary of non-steroidal anti-inflammatory drugs administered to test and control dogs.

Test Dog Number	NSAID		Control Dog Number	NSAID
T-01	None		C-01	None
T-02	None		C-02	None
T-03	None		C-03	None
T-04	None		C-04	Carprofen
T-05	Carprofen		C-05	Carprofen
T-06	None		C-06	Carprofen
T-07	None		C-07	Previcox® (firocoxib tabs)
T-08	Carprofen			
T-09				
T-10	Carprofen			
T-11	Galliprant® (grapiprant tabs)			
T-12	Galliprant® (grapiprant tabs)			

Table 3: Summary table of the changes for the Control Group and Test Group for the 7 outcomes measured: weight bearing stance on affected limb (increased measurement value = improved), lameness scores (decreased score = improved), stifle extension/flexion (increased measurement value = improved) and thigh circumference measurement (increased measurement value = improved).

	Weight Bearing Stance^ mean±SD	Lameness Score Walk mean±SD	Lameness Score Trot mean±SD	Lameness Score Total mean±SD	Stifle Extension (degrees) mean±SD	Stifle Flexion (degrees) mean±SD	Thigh Circumference measure (cm) mean±SD
Control Group Pre-Treat	9.3±4.3%	3.0±1.73	3.6±1.27	6.57±2.99	138±12.96°	54.0±9.0°	25.4±7.7
Control Group Post-Treat	11±5.1%	2.29±1.50	2.6±1.51	4.86±2.91	146.9±8.23°	54.3±9.7°	25.5±7.8
Control Group Improvement	1.7±3.1% *p*=0.31 ↑ 18.3%	0.71±0.76 *p*=0.125 ↓ 23.6%	1.0±0.82 *p*=0.063 ↓ 27.8%	1.71±1.25 *p*=0.03* ↓ 26%	8.86±5.98° *p*=0.02* ↑ 6.4%	0.3±4.8° *p*=0.81 ↑ 0.5%	0.06±0.28 *p*=0.59 ↑ 0.23%
Test Group Pre-Treat	8.9±4.0%	3.3±1.35	3.4±1.24	6.42±2.81	134±7.14°	58.8±10.0°	25.1±7.2
Test Group Post-Treat	15.5±7.4%	1.5±0.53	1.75±0.87	3.0±1.54,	148.4±5.21°	50.8±4.65°	25.7±7.3
Test Group Improvement	6.5±8.1% *p*=0.03* ↑ 73%	1.91±1.14 *p*=0.003** ↓ 57.8%	1.67±0.78 *p*=0.001** ↓ 49.1%	3.42±1.93 *p*=0.001** ↓ 53.3%	14.4±6.95° *p*=0.0005** ↑ 10.7%	8.0±10.5° 0.03* ↑ 13.6%	0.63±0.92 *p*=0.05* ↑ 2.5%
Difference Between Groups Pre-Treat	*p*=0.61	*p*=0.806	*p*=0.808	*p*=0.91	*p*=0.12	*p*=0.29	*p*=0.97
Difference Between Groups Improvement	*p*=0.19	*p*=0.016*	*p*=0.105	*p*=0.03*	*p*=0.06	*p*=0.10	*p*=0.27

^Affected limb; Pre-Treat=Pre-Treatment; Post-Treat=Post-Treatment
Statistically significant * $p<0.05$, ** $p<0.01$

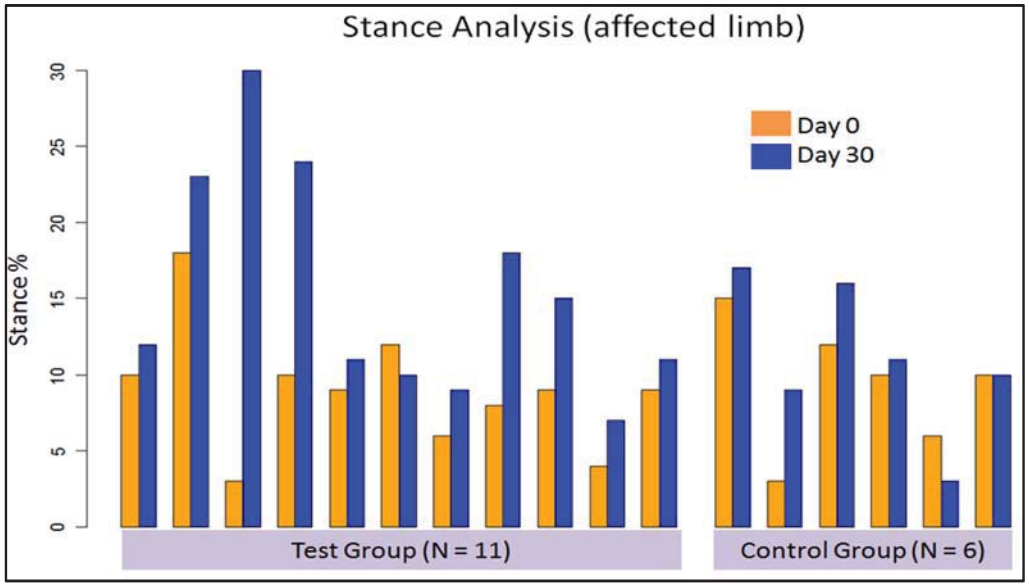

Figure 2: Stance analysis of weight bearing (percent) on the affected limb before (Study Day 0) and after (Study Day 30) in each subject; note the very marked improvement in several dogs in the Test Group.

The thigh circumference of the affected limb was measured for each subject. The mean±SD thigh circumference in the Test Group prior to treatment was 25.1±7.2 cm (median=23.6) and was 25.7±7.3 cm (median=23.6) following treatment. This small increase (mean±SD=0.63±0.92; median=0.35) was statistically significant (p=0.05). For the Control Group, the mean±SD thigh circumference of the affected limb prior to treatment was 25.4±7.7 cm (median=27.2) and 25.5±7.8 cm (median=26.8) after treatment. This improvement (mean±SD=0.06±0.28, median=0.10) was not statistically significant (p=0.59). The difference in thigh circumference before treatment was not statistically significant between the two groups (p=0.97). The group difference in improvement following the treatment was not statistically significant (p=0.27). The group difference in improvement following the treatment was not statistically significant (Test Group 2.5% vs. Control Group 0.23%; p=0.27) based on the Wilcoxon Rank Sum Test (Table 3).

Seven TCVM Patterns were identified in the Test Group (Table 4). All subjects were diagnosed with Liver *Yin* and Blood Deficiency due to the comorbidity of cranial cruciate disease. Two dogs had only this pattern and no other accompanying pattern(s). Incidence of the other patterns included: Fixed *Bi* Syndrome (1/12), *Qi* Stagnation (3/12), *Bi* Syndrome due to Kidney *Yin* Deficiency (2/12), *Bi* Syndrome due to Kidney *Yang* Deficiency (2/12), *Bi* Syndrome due to Kidney *Qi*/*Yang* Deficiency (2/12), *Bi* Syndrome due to Kidney *Qi*/*Yin* Deficiency (1/12) and 1 dog had both Fixed *Bi* Syndrome and *Qi* Stagnation.

DISCUSSION

Cranial cruciate disease is one of the most common causes of pelvic limb lameness in the dog and the early degenerative changes are invariably followed by osteoarthritis, decreased range of motion and muscle atrophy leading to persistent pain with lameness. The current nonrandomized controlled partially blinded study

Table 4: TCVM Pattern diagnosis and Chinese herbal medicine formulas prescribed for each subject in the Test Group.

Subject	Tongue Characteristics	Pulse Characteristics	TCVM Diagnosis	Chinese Herbal Medicine
T-01	Dark Pink/ Dry	Thready; Weaker on L	Liver *Yin* and Blood Deficiency Kidney *Yin* Deficiency	Tendon/Ligament *Di Gu Pi San*
T-02	Lavender/ Clear coating	Weak bilaterally	Kidney *Qi/Yang* Deficiency Liver *Yin* and Blood Deficiency	Dok's Formula Tendon/Ligament
T-03	Purple/ Dry No Coating	Rapid; Neither Strong or Weak	*Qi* Stagnation Liver *Yin* and Blood Deficiency	Body Sore Tendon/Ligament
T-04	Purple/ Deep Fissures	Rapid	Liver *Yin* and Blood Deficiency *Qi* Stagnation	Tendon/Ligament Body Sore
T-05	Lavender/ Clear coating	Weak but regular	Liver *Yin* and Blood Deficiency Kidney *Qi/Yang* Deficiency	Tendon/Ligament Dok's Formula
T-06	Pink/ Dry	Thready and Weak	Liver *Yin* and Blood Deficiency	Tendon/Ligament
T-07	Pale Pink/ Clear coating	Neither Deep nor Weak	Kidney *Yang* Deficiency Liver *Yin* and Blood Deficiency	Loranthus Tendon/Ligament
T-08	Purple/ White coating	Weak and Slow bilaterally	Liver Blood Deficiency *Qi* Deficiency Fixed *Bi* Syndrome	Tendon/Ligament Body Sore Coix Formula
T-09	Red/ Dry No coating	Thready	Liver *Yin* and Blood Deficiency Kidney *Yin* Deficiency	Tendon/Ligament *Di Gu Pi San*
T-10	Dark Pink/ No coating	Thready	Liver *Yin* and Blood Deficiency Kidney *Yin/Qi* Deficiency	Tendon/Ligament *Di Gu Pi San*
T-11	Pink/ Clear coating	Tight/ Weaker on L	Liver *Yin* and Blood Deficiency	Tendon/Ligament
T-12	Pale Purple/ No coating	Deep and Weak; Weaker on R	Kidney *Yang* Deficiency Liver *Yin* and Blood Deficiency	Loranthus Formula Tendon/Ligament

investigated using an integrative medicine approach to manage pain and joint dysfunction. Nineteen client owned dogs with cranial cruciate disease in at least one leg were divided into conventional therapy (n=7) or TCVM treatment added to conventional therapy (n=12) according to owner desired treatment approach. TCVM treatment for 30 days consisted of pattern-based acupuncture and Chinese herbal medicine added to a dog's current therapy (NSAIDs, rehabilitation exercises). Conventionally treated dogs were only treated with the later therapies for the same amount of time.

Seven quantitative measurements considered to be relevant to the patient population's stifle joint pain were included in study assessments: improved weight bearing on the affected limb, lameness scores, stifle extension/flexion ROM and thigh circumference measurement. In the first quantitative measurement (weight bearing on the affected limb), dogs were walked onto a pressure-sensitive stance analysis mat by a technician unaware of study group assignments. The stance analysis system[d] then displayed percent weight bearing analysis of each limb which was recorded by the technician. At pre-treatment baseline assessment, there was no statistically significant difference (p=0.61) between mean±SD affected limb weight bearing between control and test dogs (9.3±4.3% vs 8.9±4.0%, respectively). At study termination, both groups had improved (11±5.1% control and 15.5±7.4% test), however, the Test Group demonstrated greater change at 73% improvement when compared to 18.3% improvement for control dogs (Table 3).

The next 6 measurements (gait parameters, goniometry) were evaluated by the primary investigator (JS). Lameness was evaluated at walk, trot and total overall lameness (walk + trot). At study start, there was no statistically significant difference between any of the lameness scores between groups: p=0.806 (walk), p=0.808 (trot), p=0.910 (overall lameness). Post-treatment, the lameness score improvement for all 3 categories varied between 23.6% to 27.8% for control dogs and 49.1% to 57.8% for test dogs with a statistically significant greater improvement for test dogs when compared to controls in the walk and overall lameness categories (p=0.016 walk and p=0.03 total lameness). All improvement changes for test dogs was statistically significant while controls had statistically significant improvement for the total lameness score (Table 3).

Measured joint angles (stifle extension/flexion) also improved for both study groups with no difference between groups pre-treatment (p=0.06 extension, p=0.10 flexion) changing post-treatment to angle improvement 6.4% (extension)/0.5% (flexion) for controls and 10.7% (extension)/13.6% (flexion) for test dogs. Stifle extension improvement was statistically significant for both study groups (p=0.02 control vs p=0.0005 test) and stifle flexion only statistically significant in the Test Group (p=0.03). Thigh circumference measurement using a spring-loaded device to minimize error/bias was the final quantitative score measured. At study start there was no difference in this measurement between groups (p=0.97) and at post-treatment assessment it had improved by 0.23% for controls and 2.5% for test dogs which was statistically significant (p=0.05).

There are human studies noting the benefit of acupuncture treatment for knee arthritis and following knee replacement surgeries.[11,12] These patients had severe degenerative joint disease which after unilateral and bilateral acupuncture treatment had improved knee scoring, exercise tests and visual analogue scores in both the randomized and nonrandomized studies.[11,12] In dogs, one prospective randomized study investigated using an integrative approach for management of chronic pain and quality of life. The study enrolled 181 dogs diagnosed with musculoskeletal and neurological disease for a treatment period of 24 weeks. Study conclusion was that the use of acupuncture alone or in combination with analgesics reduced pain and improved quality of life in dogs in a statistically significant manner.[13] In a different double blinded repeated measures therapeutic trial, 47 client-owned dogs with naturally occurring lameness were assessed for clinical response to 4 treatments over a 30-day period. Comparison between pre- and post-treatment results demonstrated that combined acupuncture and manual therapy provided immediate short-term improvement for a number of parameters including walking ($p < 0.001$), trotting ($p = 0.002$), jumping ($p < 0.001$), rising from a lying position ($p < 0.001$) and reduced stiffness after rest ($p < 0.001$) or following exercise ($p < 0.001$).[14] In addition to these acupuncture studies, the use of Chinese herbal medicine to treat cranial cruciate disease was evaluated. This retrospective study looked at the records of 181 dogs, confirmed through radiographs and physical examination to have cranial cruciate ligament rupture, and tracked their response to the administration of a novel Chinese herbal medicine formula.[15] Study findings documented a 166/181 (91.7%) excellent response to the herbal formula (no surgery) and 15/188 (8.3%) non-responders (surgery required). The results of these studies for acupuncture and Chinese herbal medicine correlate well with the results of the current study.

Evaluating and quantifying the effects of acupuncture on pain is a complex process. First, there are multiple types of acupuncture including dry needle acupuncture and electro-acupuncture. Second, acupuncture point selection varies based on a practitioner's choice and TCVM Pattern differentiation thus confounding standardization of treatments.[16,17] With this in mind, despite the positive findings reported in this study, there were limitations to its conduct. Group assignments were not randomized due to owners' desires and acceptance of TCVM treatment. Based on the investigator's observations, the factors that affected a client's decision for a treatment option were: (1) lack of confidence in TCVM, and (2) additional cost of the integrative procedures. While the investigator did not anticipate that either of these factors would bias the outcome measurements used for this investigation, the

study examined subjects' characteristic data as well as the pre-treatment lameness condition to confirm the comparability between the two subject groups. Additionally, the study was not completely blinded. The computerized stance mat analysis was done by a technician, who was blinded to subjects' groups; however, due to the technicians' limited qualification and the investigator was the sole veterinarian for this study, blinding for assessments on the other measurements was not possible.

To mitigate potential bias, with the thigh circumference measurements, the investigator used a spring-loaded measurement device, which showed exactly (and quantitatively) how much tension was applied to the tape. This method, along with those for measurements of ROM and lameness grading, followed protocols recommended by Millis and Levine.[18] Although these study conduct flaws open up results to bias, it is interesting to note that the blinded observation supported the improvement noted in other categories with a 73% improvement for the Test Group versus 18.3% improvement for the controls. In addition, the two outcomes that demonstrated statistically significant improvement for the controls were both in categories that were evaluated by the principle investigator (overall lameness and stifle extension).

Finally, the short time duration for post-treatment assessments is also a limitation as longer duration of follow up would yield additional information on mobility and comfort level long term. It is interesting to note, however, that Lane et al conducted their study (acupuncture and manual therapy) for the same period of time as the present study (30 days, 4 acupuncture treatments) and saw statistically significant improvement in pain parameters starting after the second treatment. In addition to study length, a larger sample size would aid statistical evaluation for more definitive conclusions in categories where there were biological trends but not enough animals to achieve statistical significance. Increased animal numbers would also allow more detailed examination on treatment effects in dogs of varying ages, breeds, body condition (obesity) and body weight which this study was unable to investigate.

In summary, this study found adding TCVM therapies to a conventional treatment plan of rehabilitation and conventional pain-relief medications improved treatment effectiveness. The Chinese medicine herbal formulations were well tolerated, easy to administer with no adverse reactions noted. Future studies including randomization and blinding of lameness scoring, use of kinematic gait and force plated analysis that would be additive to the stance mat results would be ideal to validate the findings of this small study. The results of this study suggest that clinicians looking to improve pain relief and decrease NSAID use in patients either due to adverse events or advanced age would derive benefit for their patients by adding this integrative therapy to their treatment protocols.

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Declaration of Interest

The author declares there is no conflict of interest that could be perceived as prejudicing the impartiality of this paper.

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FOOTNOTES

a. Canine dry land exercise equipment, TotoFit LLC, Colchester, CT, USA
b. Millenia sterile acupuncture needles, Distributed by UPC Medical Supplies Inc, South El Monte, CA, USA
c. Jing Mei Electro-Acupuncture Stimulator JM-2A, Wuxi JiaJian Medical Instrument Inc., Wuxi, China.
d. Dr. Xie's Jing Tang Herbal Inc., Reddick, FL, USA
e. Stance Analyzer, Companion Animal Health, New Castle, DE, USA
f. 6" and 8" round goniometers, Elite Medical Instruments, Fullerton, CA, USA
g. Gulick II measuring tape with spring tension, Country Technology, Gays Mills, WI, USA
h. R version 3.5.2., The R Foundation for Statistical Computing, Vienna, Austria http://www.R-project.org

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