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Efficacy of *Tui-na* for Treatment of Osteoarthritis: A Systematic Review and Meta-analysis

Nicole Sczypiorski

ABSTRACT

Osteoarthritis (OA) is one of the most common causes for chronic joint pain in canine patients. The objective of this systematic review and meta-analysis study was to determine whether *Tui-na* can be an effective treatment for osteoarthritis when performed alone or part of a multi-modal approach. All studies using *Tui-na* as a treatment for OA published in peer-reviewed journals were considered in initial search results. To be included in the meta-analysis, the study must have reported statistical results associated with one of the following endpoints: 1) relief of pain; 2) improvement of mobility; 3) improved quality of life. There were 10 articles in experimental OA animal models and 18 in human clinical studies that met inclusion criteria. Overall *p*-value on experimental OA animal model studies was 4.47×10^{-11}, suggesting that *Tui-na* treatments were significantly effective when compared to model control animals not receiving treatments. Overall *p*-value on human studies was 6.74×10^{-13}, also suggesting that *Tui-na* treatments can be effective for treating OA-related diseases in human patients. With treatment effective rate available in 14 human studies, meta-analysis performed with effect size model revealed a significant overall group effect ($p = 6.72\times10^{-10}$), suggesting patients treated with *Tui-na* can have a higher effective rate than those treated without receiving *Tui-na*. The positive results on experimental model and human clinical studies indicate that *Tui-na* treatments have potential to be an effective treatment option for veterinary patients with OA conditions.

Keywords: human, massage, meta-analysis, osteoarthritis, systematic review, *Tui-na*, veterinary

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ABBREVIATIONS

GMWW	Gastrocnemius muscle wet weight
NSAID	Non-steroidal anti-inflammatory drug
OA	Osteoarthritis
RCTs	Randomized controlled trials
TCM	Traditional Chinese medicine
TCVM	Traditional Chinese veterinary medicine
VAS	Visual analogue score

Osteoarthritis (OA) is one of the most common causes for chronic joint pain in dogs. Many studies quote a prevalence of OA as high as 20% in North American dogs over one year of age, and anywhere from 6.6% up to 20% in United Kingdom dogs.[1,2] Primary OA that affects multiple joints in young dogs is rare.[3] Most cases of OA are secondary to an underlying problem or condition that leads to abnormal, repetitive stress on a joint.[4] The most commonly affected joints in dogs are the stifles, hips and elbows, though any joint in the body can be affected.[2] Predisposing factors include abnormal development of a joint, joint instability secondary to trauma, genetics, diet and exercise levels.[2] The prevalence of canine obesity is on the rise, and increased body weight relative to size is known to be a causative factor in OA.[4]

Osteoarthritis is a life-long disease that, as of yet, cannot be cured. It is typically diagnosed based on physical exam findings, subjective lameness scores and imaging. Checking for myofascial pain, areas of muscle tension or tenderness, and a good orthopedic examination that includes evaluating gait and range of motion are all helpful in identifying sources of discomfort.[5] Veterinarians often prescribe treatments to manage clinical signs associated with OA including pain management, improved mobility and a slowing-down of the disease process.[6] A multimodal approach is often the best course of action, and controlling pain is an essential first step. Non-steroidal anti-inflammatory drugs (NSAIDs) account for over 90% of analgesics prescribed for OA, but nonselective inhibition of prostaglandins can lead to complications with the gastrointestinal, renal and hepatic systems.[2] Surgery is an option for some dogs, however, most surgical procedures

are considered salvage procedures that aim to replace or fuse the affected joint or alter bone structure to correct load-bearing. Rehabilitation for animals is modeled after protocols proven to be beneficial in humans. Some of the modalities incorporated include swimming, walking, stretching and massage.[7]

Tui-na is one of the branches of traditional Chinese (veterinary) medicine (TCM/TCVM). It is considered a manual therapy, best thought of as a combination of conventional massage, chiropractic manipulation and acupressure that applies manipulations to specific acupuncture points, Meridians and limb-stretching movements.[8] Used as a sole treatment or combined with other modalities, *Tui-na* can benefit musculoskeletal disorders, improve metabolism and blood circulation, increase physical fitness and improve many other conditions where the touching and manipulation of an individual's body is not contraindicated.[9]

Any stiffness or pain in the joints, muscles, tendons or bones that results in gait abnormalities and/or deformities is referred to as *Bi* syndrome in TCVM. Osteoarthritis, degenerative joint disease and intervertebral disc disease all fall under this category. There are four Excess Patterns seen with *Bi* syndrome that include Wind, Cold/Painful, Damp/Fixed and Heat while Bony *Bi* syndrome is a Deficiency Pattern (Kidney *Qi, Yang*, and/or *Yin* Deficiency).[10] Using TCM principles, *Tui-na* works to treat imbalances associated with *Bi* syndrome by moving *Qi* and Blood to relieve pain, regulating internal *Zang-fu* (organ) functions and restoring balance of *Yin* and *Yang*.[8]

Animal-specific physiological responses and mechanisms of action of massage in general are not fully described, but are believed to produce effects via different physiological, mechanical and biochemical pathways. This may include: increased lymph flow and improved circulation, changes in sympathetic and parasympathetic responses, increased neural activity at the spinal and subcortical levels, serotonin and endorphin release, stimulation of receptors in the skin inducing vagal stimulation and relaxation, and myofascial release that enables connective tissue to return to its normal fluid state.[11]

Systematic review and meta-analysis of the effectiveness of a medical intervention is considered an excellent source of evidence to answer a medical question. The main objective of this study was to use a systematic review and meta-analysis to determine whether *Tui-na* can be an effective treatment for osteoarthritis when performed alone or as part of a multi-modal approach. The hypothesis was that *Tui-na* would be helpful in treating patients with OA by relieving pain, improving mobility and/or improving quality of life. Due to the lack of published clinical studies on assessing efficacy of *Tui-na* for treatment of canine OA patients, the majority of included research was from human medicine with the goal that this information could be extrapolated to the veterinary field and used to help define areas of interest for future canine OA research in the field of TCVM.

MATERIALS AND METHODS

Literature for the systematic review was obtained through the following search engines: Library & Information Resources Network, Google Scholar, Science Direct, National Library of Medicine and China National Knowledge Infrastructure. The keywords used to find relevant studies were: "*tuina*" (including *tui na* and/or *tui-na*), "veterinary" (and/or "animal"), "osteoarthritis" (and/or "arthritis"), "pain," "degenerative joint disease," and "massage" (and/or "manual therapy"). Titles and abstracts were examined to narrow down the thousands of initial search results. Then articles were reviewed to ensure inclusion and exclusion criteria were met.

Inclusion and Exclusion Criteria

All studies involving *Tui-na* and osteoarthritis that were published in peer-reviewed journals were considered in initial search results, regardless of species, date of publication or language, provided English translations were available. These results included prospective and retrospective studies of controlled clinical trials. *Tui-na* treatment could be compared to placebo or conventional medicine. It could also be combined with additional modalities (including conventional medicine) and compared to conventional medicine alone. Studies had to demonstrate one of the following endpoints and provide a statistical analysis of the outcome: 1) relief of pain; 2) improvement of mobility; and/or 3) improved quality of life.

Studies that could not conclude the efficacy of *Tui-na*, were not designed to test *Tui-na*, alone or separately, where useable outcome measurements were not provided, and studies that were not controlled experimental trials were all excluded.

Quality Assessment

For each of the articles included in the meta-analysis, the quality of the study was assessed based on the Jadad Scale.[12,13] The scale, ranging from 0 to 5, is widely used in systematic review studies for assessing the quality of randomized controlled trials. The assessment is based on the following three criteria: 1) randomization – score 1 if mentioned; score 2 if the method described; 2) blinding – score 1 if mentioned; score 2 if the method described; and 3) data outcome – score 1 if the fate of all subjects (e.g. complete the trial, drop-out, excluded due to protocol deviation) in the trial was known. A score of 0-2 was considered to be poor quality, 3 was fair, and 4-5 was of high quality.

Statistical Meta-analysis

The objective of the meta-analysis in systematic review research is to combine the results of multiple independent, but similar, well-designed studies to obtain an overall estimate of the statistical significance of a medical question (e.g. evaluating effectiveness of a treatment,

prevalence of diseases). One way to achieve this with sufficient robustness is to apply Stouffer's Z-score method. The method first converts the *p*-value from each individual study to a Z-score (inverse of normal cumulative distribution function), and then calculate an overall Z-score by dividing the sum of all individual Z-scores by the square root of the number of studies. The overall significance (*p*-value) can then be calculated by the normal cumulative distribution function. If the overall *p*-value is less than 0.05, it is considered that the evidence from the reviewed studies supports the study hypothesis that *Tui-na* treatment is effective for treating patients with OA. For studies that reported open intervals for *p*-values (such as "$p < 0.01$" or "$p > 0.05$"), to be conservative, the worst possible *p*-values (i.e. least significant) were used for meta-analysis. This approach helps ensure that the statistical significance of each study is not falsely overestimated.

The current study also performed meta-analysis based on effect size model, which compares a common outcome measurement (e.g. standardized group mean difference, correlation, or odds ratio) to test effectiveness. Based on the effect size and variance in each study, the analysis included the estimate of homogeneity among studies and then a Z-statistic was calculated to test the null hypothesis.

RESULTS

A total of 9,874 articles included the relevant search terms "*tuina*" (and variations) and arthritis (and variations). Removal of duplicates and review of titles for relevance resulted in a total of 92 articles warranted for in-depth review and assessment to determine their inclusion for meta-analysis. Among these articles, 16 were experimental OA animal models with rats or rabbits; 57 were human clinical studies; 18 were review articles (including systematic review studies); and one was a survey study (Figure 1). Some reports were only available in abstract format, and therefore, their assessments were based on the information provided in the abstract. After exclusion of the review studies and survey, within these categories it was determined that the meta-analysis would be conducted among studies in experimental OA animal models and human clinical studies. Due in part to the well-defined inclusion/exclusion criteria, nearly all of these studies were at least of fair quality.

Experimental Animal Model Osteoarthritis Studies

There were 10 experimental animal model OA studies that met the inclusion/exclusion criteria for meta-analysis (Table 1).[14-23] Among the 10 experimental model studies qualified for inclusion, all reported results on *Tui-na* treatment group vs. model control group (no treatment). There were multiple outcome measurements, and all but one study applied a randomization method. All experimental animal model studies received a Jadad quality score of 3. Among those measurements, the gastrocnemius muscle wet weight (GMWW) was reported in the greatest number of studies (5), and hence, statistical significance on GMWW in these 5 studies was sampled for meta-analysis. Measurements reported in the other 5 studies included gait score, fasted blood glucose, muscle tension, paw withdrawal threshold/latency and several protein expressions such as TNFα and IL-1β. For these 5 studies, to be conservative,

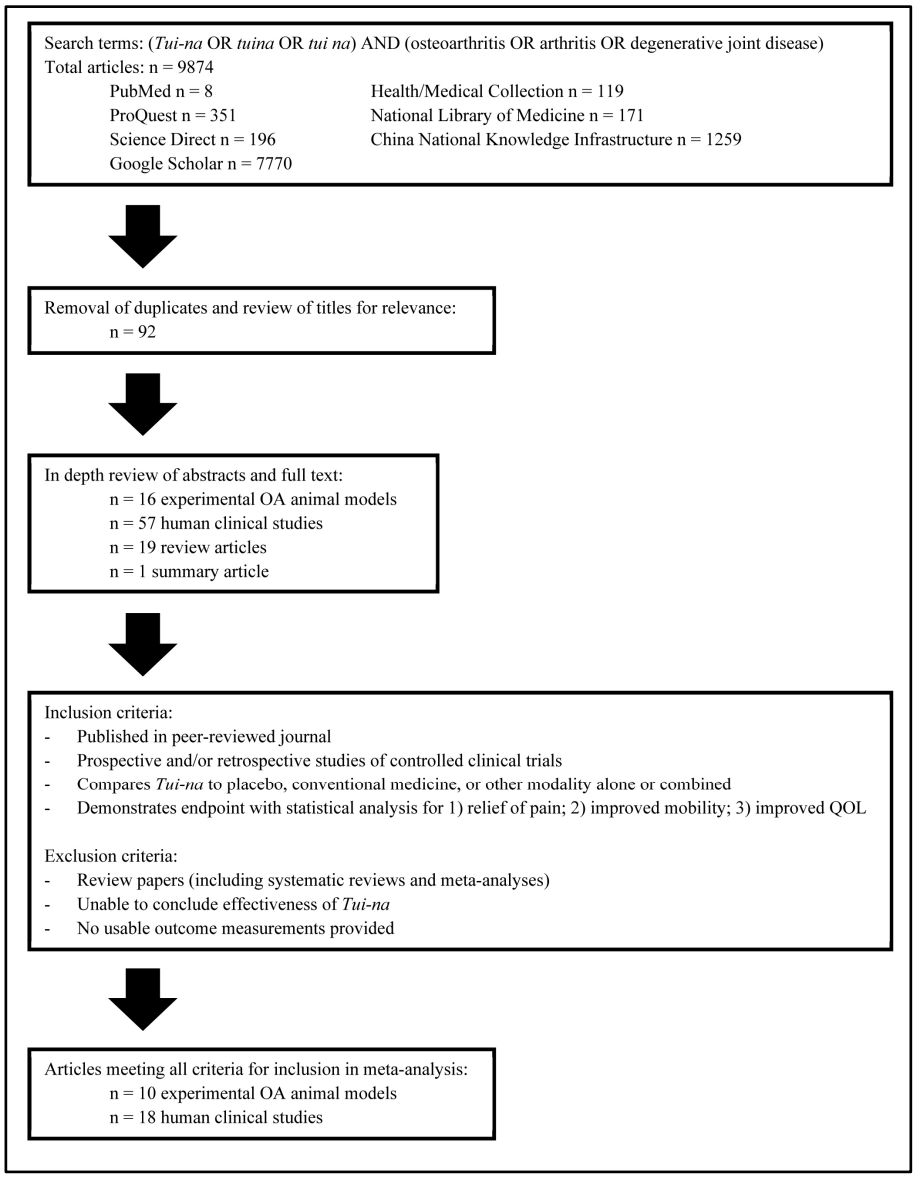

Figure 1: Flow chart of search strategy used to identify viable studies for inclusion in a systematic review and meta-analysis of the efficacy of *Tui-na* for the treatment of osteoarthritis (OA).

the least statistically significant outcome was used. The sample size for these studies ranged from 6 to 35 in each treatment group (Mean±SD = 14.3±10.5).

Stouffer's Z-scores converted from each reported *p*-value were generated on each of the 10 studies. All studies reported outcomes with statistical significance (i.e. $p < 0.05$). The overall *p*-value from this meta-analysis was 4.47×10^{-11}, which was significant. Due to the unavailability of actual outcome data (for example, Mean±SD) from any of the experimental animal studies included in this systematic review, meta-analysis based on effect size could not be carried out.

Human Clinical Studies Evaluating *Tui-na* Treatment of Osteoarthritis

There were 18 human clinical studies/articles that met the inclusion/exclusion criteria for meta-analysis (Table 2).[24-41] Of the 18 studies included, all but two mentioned the use of a randomization method for group assignments, and all studies reported outcomes based on effective rate and/or visual analogue score (VAS) data. Jadad study quality assigned a score of 4 for a knee OA clinical trial[41], 8 received a score of 3 [25-28,30,37,39,40], and 9 received a score of 2+ because the method of randomization was not clearly stated in the translated abstract available to the author.[24,29,31-36,38]

Table 1: Summary of experimental animal model studies that qualified for meta-analysis. Sample size is the number of animals in each group. In each study, a *p*-value of < 0.05 demonstrated the outcome measurement of the *Tui-na* treatment group was better (more significant) when compared to the model control, suggesting that *Tui-na* was directly responsible for the observed changes.

Study 1st Author, Year	Animal Model	Model Type	Sample Size	Outcome Measurement	Results
Gou, 2020	Rabbits	Denervated skeletal muscle	6	GMWW*	$p < 0.05$
Huang, 2020	Rabbits	Lumbar disc herniation	10	Gait score	$p < 0.01$
Lu, 2019	Rabbits	Denervated skeletal muscle	6	GMWW	$p < 0.05$
Zhao, 2019	Rabbits	Lumbar disc herniation	10	TNF-α	$p < 0.05$
An, 2019	Rats	Denervated skeletal muscle	35	GMWW	$p < 0.05$
Wang, 2018	Rats	Glycolipid metabolism injury	8	Fasting blood glucose	$p < 0.05$
Wang, 2018	Rabbits	Cervical spondylopathy	10	mRNA expression of ATP	$p < 0.05$
Fu, 2018	Rats	Denervated skeletal muscle	32	GMWW	$p < 0.05$
Song, 2018	Rats	Analgesia of dorsal root ganglia	10	Paw withdrawal threshold	$p < 0.05$
Guo, 2016	Rats	Denervated skeletal muscle	16	GMWW	$p < 0.01$

*GMWW = gastrocnemius muscle wet weight

Table 2: Summary of human clinical studies that qualified for meta-analysis. "Sample size" is the number of individuals in each group. "Treatment Comparison" column describes the group comparison of each study for *Tui-na* treatment's efficacy, which includes (*Tui-na* +/- Treatment X) vs. (Treatment X alone), or (*Tui-na)* vs. (Treatment X), where Treatment X can be a conventional medicine (such as NSAID), exercise (such as sling/traction), or traditional Chinese medicine treatment (such as acupuncture, herbal medicine).

Study 1st Author, Year	OA-related Disease	Sample Size	Treatment Comparison	Outcome Measurement	Results
Mei, 2020	Myofascial pain syndrome	60	*Tui-na* + Herbal + Piroxicam gel vs. Herbal + Piroxicam gel	TER: 96.7% vs. 81.7%	$p = 0.016$
Li, 2019	Vertebral artery type cervical spondylosis	30	AP+ Herbal + *Tui-na* vs. AP + Herbal	TER: 90% vs. 80%	$p = 0.472$
Ding, 2019	Lumbar disc herniation	28	*Tui-na* + Sling vs. Sling	TER: 75% vs. 64.3%	$p = 0.562$
Yu, 2019	Lumbar disc herniation	68	*Tui-na* + Sacral canal blocking vs. Sacral canal blocking	TER: 95.6% vs. 82.4%	$p = 0.026$
Zhang, 2019	Vertebral artery type cervical spondylosis	60	*Tui-na* + AP vs. AP	TER: 91.7% vs. 76.7%	$p = 0.043$
Wang, 2018	Knee osteoarthritis	50	*Tui-na* + Moxibustion vs. Moxibustion	TER: 96% vs. 78%	$p = 0.015$
Yao, 2018	Knee osteoarthritis	36	*Tui-na* vs. NSAID	TER: 97.1% vs. 80.6%	$p = 0.307$
Xu, 2018	L5-S1 intervertebral disc herniation	43	*Tui-na* + AP vs. AP	TER: 97.7% vs. 86.0%	$p = 0.110$

Table 2 cont.

Study 1st Author, Year	OA-related Disease	Sample Size	Treatment Comparison	Outcome Measurement	Results
Qu, 2018	Chiasma-type lumbar disc herniation	33/30	*Tui-na* + Herbal + Traction vs. Herbal + Traction	TER: 93.9% vs. 73.3%	$p = 0.038$
Yao, 2018	Spondylotic radicular cervical spondylosis	50/45	*Tui-na* + AP vs. AP	TER: no percentage given	$p < 0.05$
Yuan, 2018	Knee osteoarthritis	37	*Tui-na* vs. NSAID	TER: 94.4% vs. 81.1%	$p = 0.152$
Yang, 2018	Cervical spondylosis	15	*Tui-na* + Exercise vs. Exercise	Visual Analogue Score	$p < 0.05$
Mao, 2018	Primary osteoporosis	30	*Tui-na* + Herbal vs. Herbal	TER: 93.3% vs. 83.3%	$p = 0.424$
Fan, 2010	Knee osteoarthritis	48	*Tui-na* vs. NSAID	TER: 93.8% vs. 91.7%	$p = 1.000$
Ding, 2012	Cervical spondylosis	64/62	Advanced *Tui-na* vs. Routine *Tui-na*	TER: 100% vs. 88.7%	$p = 0.006$
Jiang, 2020	Cervical spondylotic radiculopathy	30	*Tui-na* vs. Electro-acupuncture	TER: 96.7% vs. 93.3%	$p = 1.000$
Wang, 2019	Chronic low back pain	30	*Tui-na* + Sling Vs. Sling	Visual Analogue Score	$p < 0.05$
Perlman, 2012	Knee osteoarthritis	24	Massage + Routine care vs. Routine care	Visual Analogue Score	$p = 5.7\text{x}10^{-6}$

AP= acupuncture; NSAID = nonsteroidal anti-inflammatory drugs; TER = total effective rate

The meta-analysis on human clinical studies obtained *p*-value data based on the following method: 1) studies reporting effective rate data (14 out of 18 studies), *p*-values were calculated using Fisher's Exact test;[24-32,34,36-39] 2) one study reporting a *p*-value based on effective rate but did not provide the data, the reported *p*-value was used;[33] 3) 2 studies only reporting VAS *p*-value outcomes used the reporting *p*-values;[35,40] and 4) one study that reported VAS outcomes with data (Mean±SD), and the *p*-value was calculated using two-sample T test.[41] The sample size for these studies ranged from 15 to 68 in each treatment group (Mean±SD = 40.7±15.1).

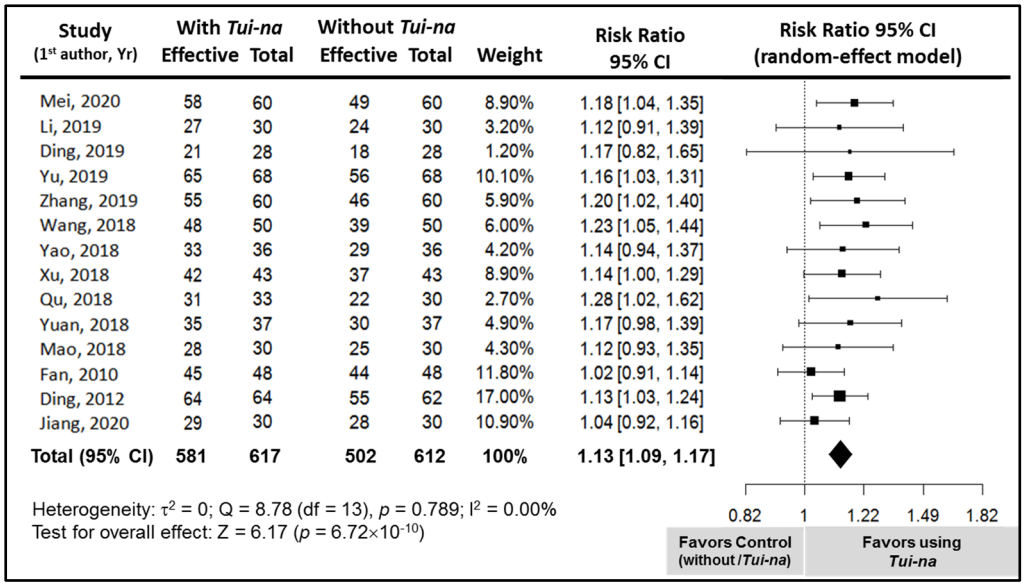

Figure 2: The results of the random effect size meta-analyses for human clinical studies are presented in this Forest plot, where each study is shown with its effect size (risk ratio; where unconventionally "risk" here means "effective") and corresponding 95% confidence interval. Risk ratio > 1 favors use of *Tui-na*, whereas risk ratio < 1 suggests *Tui-na* has no beneficial effect.

Stouffer's Z-scores converted from each obtained *p*-value using the method described above were calculated. Despite several studies not obtaining statistical significance (mainly due to smaller sample size or comparison with a positive control), the overall *p*-value from this meta-analysis was 6.74×10^{-13}, which was significant.

There were 14 studies that reported comparison of effective rate (i.e. percent of study subjects that responded favorably to treatment based on established outcome measurements) between the *Tui-na* test group and the control group (Figure 2). When only including studies with effective rate, the overall *p*-value was 1.29×10^{-8}. Test for heterogeneity did not show significant heterogeneity among studies at a 0.05 level ($p = 0.789$). The (random-effects) model on the meta-analysis revealed a significant overall effect ($p = 6.72\times10^{-10}$), which gives sufficient confidence to conclude statistical significance at an 0.05 level, suggesting that patients that received *Tui-na* treatment can have a higher effective rate than those without *Tui-na* treatment.

DISCUSSION

The present study performed a systematic review of peer-reviewed literature and meta-analysis of appropriate studies to evaluate the evidence for efficacy of OA treatment by *Tui-na* massage. The extensive literature search identified a total of 28 studies (10 experimental animal model studies, 18 human clinical studies) that met study inclusion criteria and reported statistical results associated with one of the following endpoints: 1) relief of pain; 2) improvement of mobility; 3) improved quality of life. The overall *p*-value from the meta-analysis of both the experimental OA animal model and human clinical studies, along with treatment effective rate, was statistically significant. This suggests *Tui-na* treatments can be effective for treating OA-related diseases in human patients, satisfying the study hypothesis.

The systematic literature review of experimental animal model studies demonstrated a number of statistically significant positive findings when comparing *Tui-na* treatment groups to the model controls. Through measurement of GMWW, *Tui-na* was shown to delay skeletal muscle atrophy/degeneration and improve the recovery of sensory dysfunction caused by peripheral nerve injury. [14,23] In addition, to effect these changes on a cellular level, *Tui-na* improved the expression of myogenic regulatory factors, activated factors that remove damaged organelles, promoted differentiation/maturation of muscle satellite cells and increased substrates and energy for muscle fiber regeneration.[16,18,21] In the lumbar disc herniation and cervical spondylopathy models, *Tui-na* reduced inflammatory mediators and improved the expression of adenosine triphosphate, respectively.[15,17,20] Finally, it was demonstrated that *Tui-na* improved glycolipid metabolism inflammatory injury and helped alleviate hyperalgesia by changing the expression of piezo mechanosensitive channels within dorsal root ganglia.[19,22]

The animal model studies demonstrated good pre-clinical study predictive value for treatment effects in the clinical studies. In the human clinical studies, similar to the animal models, OA treatment with *Tui-na* was shown to benefit patients with cervical spondylopathy and lumbar disc herniation. It effectively alleviated symptoms of cervical pain, reduced nerve root compression and improved function for cervical spondylotic radiculopathy, as well as vertebral artery cervical spondylosis.[25,28,33,35,38,39] In lumbar disc herniation patients, *Tui-na* demonstrated better clinical efficacy to lessen pain, reduce inflammatory factors and improve lumbar function.[26,27,31,32] In addition, patients with low back pain had improved lumbar muscle dysfunction with increased thickness of affected muscles and improved pain relief.[40] When *Tui-n*a was compared to an oral NSAID for patients with knee OA, there were improved clinical symptoms, joint function, muscle strength, pain reduction and improved short-term equivalent effects.[29,30,34,37,41] Similarly, better therapeutic advantages were realized when treating patients for myofascial pain syndrome with a combination of *Tui-na* and medication.[24] Of interest, *Tui-na* treatment improved the clinical effect and reduced pain when combined with medication for patients with primary osteoporosis.[36] Though safety and adverse events were not investigated for the purposes of the present study, when compared to readily available data from included randomized controlled trials (RCTs), systematic reviews and meta-analyses, *Tui-na* administered by a skilled practitioner, tailored to an individual patient's condition and needs, was a safe treatment with minor, transient adverse effects if and when adverse effects were noted.

There are several systematic reviews and/or meta-analyses evaluating RCTs that demonstrated comparable results to the present study. Four meta-analyses were performed in 2019 looking at the effects of *Tui-na* on underlying conditions such as knee OA (17 RCT), lumbar disc herniation (6 RCT and 121 RCT), and lumbar strain (11 articles) concluding that *Tui-na* treatment relieved pain and improved function.[42-45] Other systematic reviews and meta-analyses evaluated *Tui-na*'s usefulness for the treatment of cervical radiculopathy (5 RCT), musculoskeletal disorders (66 RCT) and low back pain (20 RCT), which again concluded favorable effects on pain and functional improvements.[46-48] One large systematic review and meta-analysis looked at massage therapy to improve function in pain populations using 67 RCTs. Study findings concluded that massage therapy should be considered as a pain management option compared to other sham or active comparators (i.e. joint manipulation, physical therapy, acupuncture).[49]

The biggest challenge to the conduct of this study was acquisition of articles for inclusion. It was difficult to gain access, search foreign databases for abstracts and obtain full text English translated versions of articles. In instances where full text translations were unavailable, the author had to rely on abstracts for relevant information which is less than ideal for complete understanding of a study. Though every attempt was made to include all relevant articles, it is possible that studies were missed. Another limitation of this project was that systematic reviews and meta-analyses are difficult to perform due to the wide variation in terms used to describe massage treatments. *Tui-na* can be considered a general term for massage associated with TCM/TCVM, but the actual massage techniques used can vary from one study to another. A general limitation to randomized controlled trials concerning *Tui-na* is that it is difficult to establish an appropriate control for massage. Any "light touch" or "sham massage" may still demonstrate some physiological or psychological change in an individual, making it difficult to perform properly blinded studies. This was a primary obstacle for many of the studies attaining high quality Jadad scores.

The difficulty of performing blinded human studies could be overcome in canine trials. Dogs suffering from OA can be evaluated both objectively (e.g. radiographs, thermograms, gait force plate analysis, range of motion) by a blinded clinician, and subjectively (e.g. VAS, quality of

life assessment, Canine Brief Pain Inventory) by both blinded clinicians and owners. A qualified *Tui-na* practitioner could treat study subjects in a separate area without either the evaluator or owner observing. This eliminates major study quality challenges of performing properly blinded studies in humans. It would also be feasible to test multiple hypotheses in a single study with an appropriate population group including: *Tui-na* alone compared to *Tui-na* plus NSAIDs compared to NSAIDs alone.

In conclusion, based on the results of this study, the hypothesis that *Tui-na* benefits treatment of OA patients by relieving pain and improving mobility and quality of life could be accepted. Although there is a lack of veterinary-related studies evaluating *Tui-na* as an effective treatment for OA, the statistically significant meta-analyses demonstrating positive results suggests *Tui-na* has the potential to be an effective treatment option alone or as part of a multimodal approach when extrapolated to dogs. It is reasonable to believe that any non-aggressive animal that is receptive to manual therapy can benefit from *Tui-na*, and the results of this study suggest high-quality, randomized, controlled clinical trials on companion animals are warranted.

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Declaration of Interest and Funding

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