Clinical Studies

A Randomized, Controlled, Blinded Study of the Effectiveness of Acupuncture for Treatment of Cervical Stiffness in Horses

Carla W Pasteur DVM, MS-TCVM

ABSTRACT
Cervical stiffness in horses is a common complaint and can adversely affect performance. Presenting signs may include resistance to turning, lameness not localized to the distal limb, poor performance, abnormal gait, loss of power, incoordination, and ataxia. The objective of this randomized, controlled, blinded study was to determine whether acupuncture (AP) can be an effective treatment for cervical stiffness in horses. Eighteen horses were randomly assigned to either the Test Group (acupuncture) or the Control Group (sham-acupuncture) with three treatments given 7-10 days apart. Lateral bend was quantitatively evaluated before the first treatment and one day after the third treatment with analysis on video recordings. Measurements were taken at the point of maximal bend (R1) and pre-compensation bend (R2). In addition, muscle mass of the neck was measured at the level of the caudal aspect of the second cervical vertebra and at the caudal aspect of the fifth cervical vertebra at the same assessment times as for lateral bend. The person taking the measurements was blinded as to treatment group. The results showed that the Test Group had significantly larger mean R1 (p = 0.019) and R2 (p = 0.008), than the Control Group. No significant difference was found in muscle mass between subject groups. These outcomes suggest that acupuncture can improve lateral bend in horses and can be an effective treatment for cervical stiffness in horses.

Key words: acupuncture, cervical, equine, stiffness, pain

*Address correspondence to Dr. Carla Pasteur (goodqi@earthlink.net).

ABBREVIATIONS

AP	Acupuncture
COM	Center of mass
DOD	Developmental orthopedic disorders
EAP	Electro-acupuncture
OA	Osteoarthritis
TCVM	Traditional Chinese veterinary medicine

Normal movement of the head and neck is important for locomotion, balance, and adjusting the load on individual limbs. The elastic structures of the neck, such as the ligamentum nuchae, store energy for locomotion and contribute to gait efficiency. Horses have a very efficient gait and are able to travel long distances while conserving energy. At a gallop, their apparent efficiency can exceed 100%.[1-7] Head position also has a mechanical effect on weight distribution. The horse's head is a large cantilevered weight at a distance from the center of mass (COM) and creates a powerful moment arm. Changes in the position and movement of the head and neck are used to affect the center of mass and the load on individual limbs in sound and lame horses.[8-11] Raising or lowering the head also changes the tension on the supraspinous ligament and therefore affects flexion and extension of the thoracolumbar vertebrae. This flexion and extension is an integral part of locomotion and helps to move the ribcage for respiration.[1,7] The position of the head affects the balance of the horse by changing the COM and by changing input to vision, vestibular, and proprioceptive systems.

Studies in humans have shown that cervical pain leads to a variety of changes. Muscle mass, recruitment pattern, timing of activation, and even fiber type are affected by pain.[12-15] Muscle mass decreases ipsilateral to the pain. Pain can alter muscle recruitment without altering the kinematics of the task.[13] This means that pain may be present before changes in movement are seen and that secondary muscles are used to accomplish the task. The activity of deep postural muscles is decreased and delayed.[16,17] This lack of, or delay of cervical spine stabilization may increase the risk of injury and lead to degenerative changes in the cervical spine. Chronic pain leads to a change in muscle fiber type from Type 1 slow twitch non-fatigueable fibers to Type 2 fast twitch fatigable fibers.[18] Type 1 fibers are used for postural muscles to stabilize the spine and resist gravity for long

From: Rising Sun Equine Clinic LLC, Ocala, FL USA
Professional Certifications: CVA, CVSMT, CERP

periods. Type 2 muscle fibers are used for movement and fatigue quickly and are not suitable for use in primary postural control muscles. Research on neck pain in humans is extensive but is lacking in the horse, although cervical pain/stiffness is a common complaint from riders.

The most commonly used treatment for equine cervical stiffness is stretching or repeatedly bending in the restricted direction. This is done, however, by the rider/trainer who hasn't had training in physical therapy or education on correct biomechanics. While exercises have been shown to re-establish normal neuromuscular control and improve specificity of muscle action; if they are done incorrectly, the therapy may reinforce poor patterns and continued joint instability. When the pain remains, the subject will continue to use compensatory patterns throughout the exercises even with good instructions and the best of intentions. Applying exercise therapy to re-establish neuromuscular control needs to be pain-free to prevent compensatory movements during rehabilitation.

Treatments such as cervical facet injections are used to control pain due to inflammation when there is radiographic change seen in the facets or when joint effusion is identified on ultrasound examination.[16] Injection of anti-inflammatory medication may increase joint range of motion to some degree. Intra-articular stem cell therapy is another treatment that is being tried.

Acupuncture, a branch of traditional Chinese veterinary medicine (TCVM), has been successfully used to treat cervical pain and stiffness associated with osteoarthritic changes in the vertebrae, nerve root impingement/ inflammation, poor neuromuscular control and tendon/ligament or muscle strain.[19-24] One of the beneficial aspects of TCVM is that it gives Western practitioners another point of view. With TCVM, the clinical signs are grouped differently and often a difficult case with several conventional medical problems will have one unified TCVM Pattern and the treatment options will be clear. In TCVM, cervical stiffness may be due to *Bi* Syndrome, which may be further divided into *Qi* or Blood Stagnation or Bony *Bi*.[25] Kidney *Jing* Deficiency can also play a role in cervical stiffness. *Bi* Syndrome is a blockage of *Qi* and/or Blood in the channels and can cause pain and difficulty with movement. Bony *Bi* relates to changes in or around the joint similar to what may be seen on radiographs or ultrasound. TCVM treatment for Bony *Bi* Syndrome focuses on clearing Stagnation and supporting bone and Kidney. Studies investigating the use of acupuncture for osteoarthritis (OA) which is the conventional diagnosis for Bony *Bi* Syndrome, have shown it to be an effective treatment in several species.[4,26,27]

Qi or Blood Stagnation, which can often occur together, relates to pain and stiffness but does not have a direct conventional equivalent diagnosis. Typically, *Qi* Stagnation is a dull aching pain that responds positively to pressure, whereas Blood Stagnation is a sharp stabbing pain that reacts negatively to pressure. The TCVM treatment is to clear the Stagnation and to tonify *Qi* and/or Blood. There are a multitude of etiologies associated with *Qi* or Blood Stagnation and can include but are not limited to: trauma from a blunt force, a fall, holding the neck in one position for a long period of time such as during transport, or invasion of pathogens like Wind or Damp.

Kidney *Jing* Deficiency is usually an inherited disorder. The clinical signs are delayed development, stunted growth, and developmental orthopedic disorders (DOD). Horses with Kidney *Jing* Deficiency often have bony and cartilage defects. Horses with wobbler syndrome or cervical vertebral stenotic myelopathy have a Kidney *Jing* Deficiency. A study published in the

Table 1: Acupoints used to treat cervical stiffness in the Test Group horses with indications and anatomic location described for each acupoint.

Acupoint	Attributes, Indications and Actions[25]	Anatomic Location
BL-10	Permission point, local point to resolve Stagnation	In a depression caudal to the wings of the atlas and 2 *cun* from the dorsal midline
Jing-jia-ji	Local to cervical facets	1.5 *cun* dorsal to the facets at the caudal border of the vertebrae
SI-3	Confluent point for the Governing Vessel Channel used for tension, tightness in the head or neck and cervical pain	In a depression on the caudolateral border of the third metacarpal bone, distal to the end of the lateral splint bone, proximal to the fetlock
BL-62	Opening point for the *Yang-Qiao* Channel for ataxia, stiffness in the spine	In a depression distal to the lateral malleolus
LI-4	Resolve cervical Stagnation and anti-inflammatory	In a depression between the second metacarpal bone and the third metacarpal bone at the upper 1/3 of the distance from the carpus to the fetlock
LIV-3	Strong point to clear Stagnation	On the craniomedial aspect of the third metatarsal bone, upper 1/3 of the distance from the tarsus to fetlock
Shen-shu	Tonify Kidney *Qi* to support bone and stabilize neck and back	Two *cun* lateral to the lumbosacral junction

American Journal of Veterinary Research showed that wobblers have a higher frequency and severity of appendicular DOD lesions, leading researchers to conclude "horses with cervical stenotic myelopathy may have a systemic failure in the development or maturation of cartilage and bone".[28] In TCVM this translates to a Kidney *Jing* Deficiency. TCVM treatment for this is to tonify Kidney and support bone. A retrospective study by Xie et al. on TCVM treatment for wobbler syndrome in horses and dogs found that the neurologic signs resolved in 52.6% and partially resolved in 42.1% of patients.[29]

In addition to treating the patterns of cervical stiffness, Bony *Bi* Syndrome, *Qi*/Blood Stagnation and Kidney *Jing* Deficiency, it is important to consider the *Yang-qiao* Channel (one of the 8 extraordinary channels). Along with the *Yin-qiao* Channel, it dominates movement of the hind limbs. Acupuncture points BL-62 and SI-3 are the opening and closing points for the *Yang-qiao* Channel.

Acupuncture point selection is based on the presenting pattern and is specific to each patient. For the purposes of this study, one set of acupoints was chosen for all subjects in the acupuncture treatment group. The points were chosen to address each of the likely patterns but keeping the total number of needles used to a minimum for patient compliance. Acupoints used in the treatment group were: BL-10, *Jing-jia-ji*, SI-3, BL-62, LIV-3, LI-4, and *Shen-shu* (Table 1). The objective of this study was to investigate the efficacy of acupuncture treatment to relieve equine cervical stiffness. The study hypothesis was that acupuncture treatment at the proper acupuncture points can improve cervical stiffness in horses.

MATERIALS AND METHODS

Horses were recruited from the clinic population of performance horses at Rising Sun Equine in Ocala, Florida, USA. Clients were asked if they had horses with difficulty in lateral bending and were willing to take part in the study. Horses were accepted into the study if they demonstrated difficulty or resistance to bringing the head laterally to the level of the axilla to the left or to the right. The participation criteria were horses at least 3 years old that had not been treated with acupuncture or facet injections in the past 3 months. The study was performed in compliance with guidelines outlined in the Animal Welfare Act (APHIS 41-35-076) and informed consent by owners was acquired for each horse that participated in the study.

Horses were randomly assigned by a computer website program[a] to one of two treatment groups: Test Group and Control Group. The Test Group received 3 electro-acupuncture (EAP) treatments, 7-10 days apart, by the same certified veterinary acupuncturist (CP) in the aisle of the barn with 25 or 50 mm 28-guage stainless steel acupuncture needles[b]. The 50 mm needles were placed at acupuncture points: BL-10, *Jing-jia-ji* (C3-4, C4-5, C6-7) and *Shen-shu.* The 25 mm needles were used at BL-62, SI-3, LIV-3 and LI-4. An electronic acupunctoscope[c] was used for the EAP treatment. Electrical stimulation was applied for 10 minutes at 20 Hz, continuous wave stimulation with intensity set just under that needed to cause muscle twitch. EAP was performed bilaterally at 1) BL-10 connected to *Jing-jia-ji* at C3-4, and 2) *Jing-jia-ji* at C4-5 connected to C6-7.

The Control Group also received three treatments, 7-10 days apart, using small 1.5 mm press needles[d] at non-acupuncture points. The 5 sites used were: 0.5 *cun* from the dorsal midline with the first needle at the level of the caudal aspect of C2 and then every two *cun* moving caudally and stopped after the fifth needle. Other points were 2 *cun* cranial to ST-10, two *cun* dorsal to ST-31, halfway between BL-53 and BL-54, and two *cun* caudal to ST-37. The Control Group retained the needles without electricity for ten minutes.

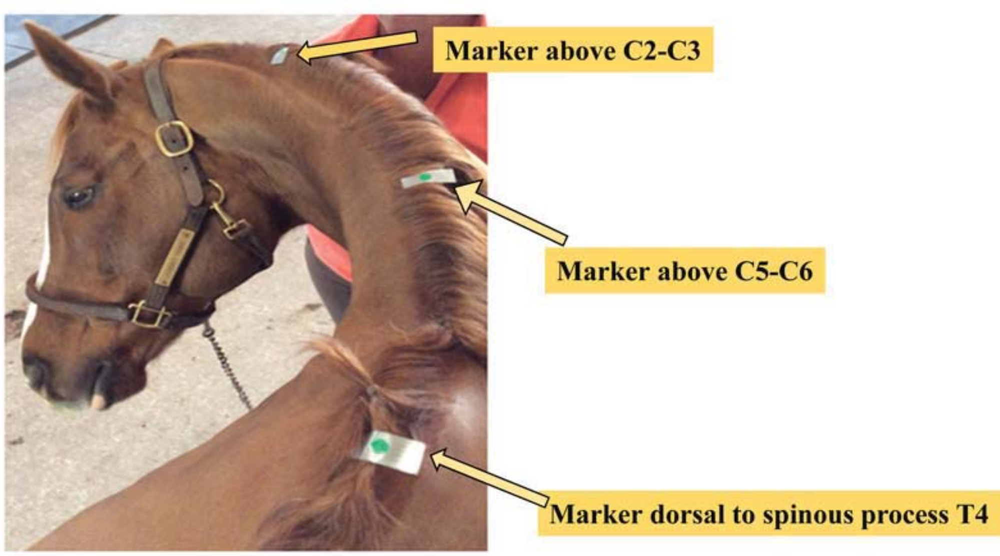


Figure 1: To assess treatment outcomes (lateral neck bend), skin markers were placed at the nuchal crest (not visible), directly above C2-C3, above C5-C6, and dorsal to the spinous process of T4.

To assess the treatment outcome (horse's ability to bend the neck), skin markers were placed by the author in 4 locations along the head and neck: 1) the nuchal crest of the skull; 2) directly above C2-C3; 3) directly above C5-C6; and 4) on the dorsal spinous process of T4 (Figure 1). Each horse was videoed by the author with an iPad[e] from above and asked to bend to the left and right. To accommodate a horse to a person standing beside and above them, each horse was asked to bend left twice without filming (with the person in place) and was filmed on the third attempt. The same procedure was done to the right. Measurements were taken immediately before the treatment and re-taken 1-3 days after the last treatment.

Bend measurements were extracted from the video with video analysis computer software[f]. Two angles were measured in each direction: 1) from skull marker to the C2-C3 marker and to the C5-C6 marker, and 2) from C2-C3 to C5-C6 and on to the T4 marker (Figure 2). Measurement of lateral bend was done pre-treatment on the first day and one day after the last treatment. One lateral bend measurement was the amount of bend before refusal and was labeled R1, maximal bend. The other lateral bend measurement was the amount of bend before compensation and was labeled R2, pre-compensation (Figures 3 and 4). The point of refusal was considered to be when the horse pulled its head away from the handler, walked forward or moved backward. Compensation was indicated by rotation at C1-C2, elevation (cervical extension) or lowering (cervical flexion) of the head from a neutral position. For both R1 and R2, the bend degrees to the left and to the right were averaged as the final measurement.

Total muscle mass measurement was also taken immediately before treatment and one day after the last treatment. The neck was held straight at a natural level and the contour from the dorsal midline was traced with a flex curve[g] at the level of C2-C3 (cranial level) and at C5-C6 (caudal level). This curve, or outline of the cross section of the neck, was transferred to paper and two measurements were taken at each level (Figure 5). The total width at the cranial level was measured at 8cm and 16cm from the dorsal midline and at 10cm and 20cm for the caudal level. The four muscle mass measurements for each subject were combined into an overall muscle mass measurement.

All of the outcome measurements were collected by one person blinded to the group assignment of each horse. Statistical inference was carried out to test the hypothesis that the improvement in the Test Group population was different from that in the Control Group population, with respect to the bend and muscle mass measurements. Distribution-free Wilcoxon Rank Sum test (nonparametric version of two-sample t test) was utilized for each of the tests. All tests were two-sided and null hypothesis was rejected when the resulting p-value was less than 5%. Assuming the probability that the outcome in the Test Group would be better than that in the Control Group was 0.85, a sample size (n = 9) in each group would achieve approximately 80% power to reject the null hypothesis with a 0.05 significance level. The statistical analysis was performed using a commercial statistical software[h].

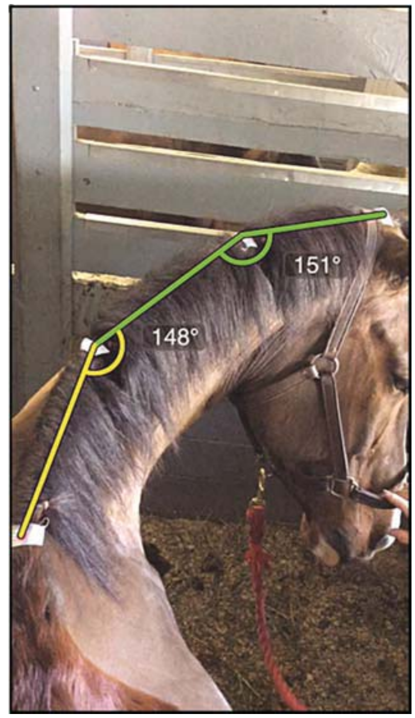
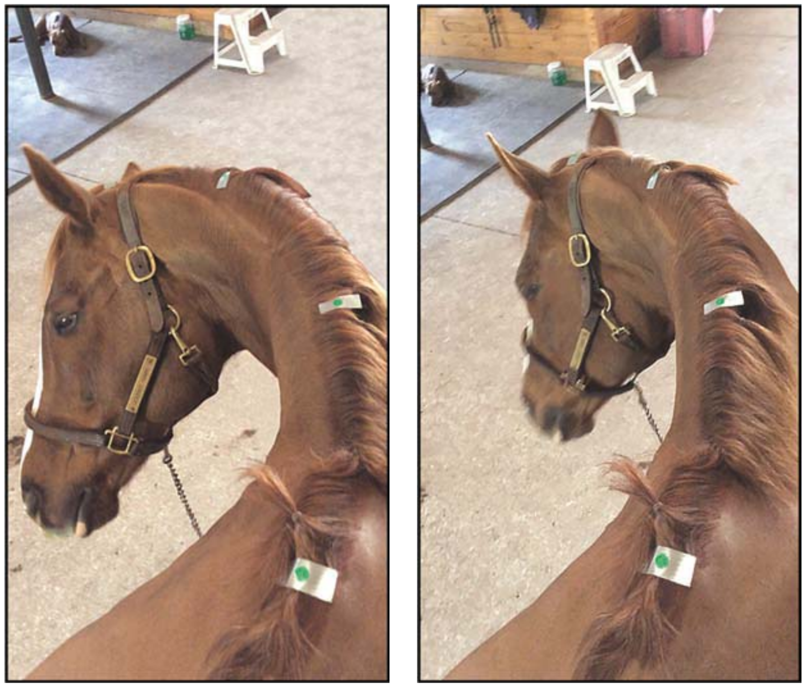


Figure 2: Example of determining lateral bend measurements which were performed on both sides of the neck. Two angles were measured 1) from skull marker to the C2-C3 marker and to the C5-C6 marker, and 2) from C2-C3 to C5-C6 and on to the T4 marker.

RESULTS

A total of 18 horses that met the inclusion/exclusion criteria were included in the study (9 in each study group). The Test Group had 2 mares and the Control Group had 3 (p = 1.00). Both groups had a median age of 15 years old with the range from 6 to 25 in the Test Group and 5 to 23 in the Control Group (p = 0.859, Wilcoxon Rank Sum test). In the Test Group, 4 were Thoroughbred, 3 were Warmblood, and the remaining 2 were Friesian and Andalusion (PRE), respectively. In the Control Group, 4 were Thoroughbred and the remaining 5 were Warmblood. There was no statistical evidence that the breed distribution was different between the test and the control groups (p-values > 0.6 with two-sample test for proportions with respect to any breed). The primary activity/use of study horses identified jumpers as the largest group participating in the study. Performance categories for test versus control horses were similar and included: jumpers (4 vs 4), dressage (3 vs 1), eventing (1 vs 1), hunter (0 vs 1) and retired (1 vs 2), respectively. There was no statistical evidence that the distributions of use were different between the test and the control groups (p-values > 0.5 with two-sample test for proportions with respect to any use) (Table 2).



R1-Maximal bend **R2**-Pre-compensation

Figure 3: The picture on the left is an example of maximal bend (R1), which is the measured amount of lateral flexion a horse could attain before refusal to bend further. The picture on the right is pre-compensation, good biomechanics bend (R2) which is the greatest lateral flexion a horse could attain before compensating by rotating, raising or lowering their head from a neutral position to get more bend; dorsal view.

R1-Maximal bend **R2**-Pre-compensation

Figure 4: The picture on the left is an example of maximal bend (R1), which is the measured amount of lateral flexion a horse could attain before refusal to bend further. The picture on the right is pre-compensation, good biomechanics bend (R2) which is the greatest lateral flexion a horse could attain before compensating by rotating, raising or lowering their head from a neutral position to get more bend; lateral view.

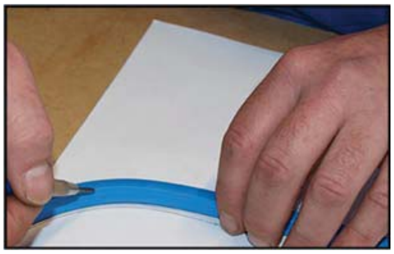


Figure 5: Muscle mass measurement using a flex curve[g]. The curve or outline of the cross section of the neck was made with the flex curve which retained its shape and then was transferred to paper.

Cervical stiffness outcome measurements were taken at two end points: maximal bend (R1) and maximal bend without any compensation, good biomechanics (R2). Comparison of mean±SD pre-treatment outcome measurements for R1, R2 and muscle mass between the Test Group and the Control Group demonstrated no statistically significant difference between test and control groups for R1 (p = 0.860), R2 (p = 0.724) and muscle mass (p = 0.377) (Figure 6).

The post-treatment R1 measurement in seven out of nine horses (7/9 = 77.8%) in the Test Group (acupuncture) when compared with pre-treatment data had increased (improved) maximal bend degree, one horse remained unchanged, and the remaining horse showed smaller bend degree after treatment (Figure 7). On the other hand, only four out of nine horses (4/9 = 44.4%) in the Control Group (sham acupuncture) had increased (improved) maximal bend degree, and the remaining five showed smaller bend degree after treatment. On average, the mean ±SD change in the Test Group was 9.83 ±8.87 degrees (median = 11.0) whereas in the Control Group the mean change was -6.83±15.26 degrees (median = -9.5). The mean change (improvement) of R1 measurement in the Test Group was statistically significant (p = 0.025) based on the Wilcoxon Signed Rank test. The mean change of R1 measurement in the Control group (-6.83 degrees) was not statistically significant (p = 0.301) based on the same test, likely due to the large deviation among the subjects. The comparison of the changes between the Test Group and the Control Group, based on the Wilcoxon Rank Sum test, revealed that the mean R1 change in the Test Group was significantly larger than that in the Control Group (p = 0.019) (Table 3).

The R2 measurement in eight out of nine horses (8/9 = 88.9%) in the Test Group (acupuncture) had increased (improved) maximal bend degree, and only one showed smaller bend degree after the treatment (Figure 8). On the other hand, only three out of nine horses (3/9 = 33.3%) in the Control Group (sham acupuncture) had increased (improved) maximal bend degree, and all of the remaining six showed smaller bend degree after the treatment. The mean change for R2 within the Test Group (12.22 ±8.82°) was statistically significant (p = 0.008), whereas the Control Group had no significant change at -5.17 ±13.07° (p = 0.301). When group comparison for R2 change was evaluated, the Test Group change was significantly larger (p = 0.008) when compared to the Control Group.

Comparison of mean change in muscle mass measurement from pre-study until 1 day after the third acupuncture session for each study horse resulted in three out of nine horses (3/9 = 33.3%) in the Test Group with increased muscle mass, and four out of nine horses (4/9 = 44.4%) in the Control Group with increased muscle mass. The mean change in the test and control groups was -2.38 ±7.09 and -1.93 ±6.66, respectively. The change was not statistically significant in either group (p = 0.301 test and 0.447 control) and when the groups were compared to each other, there was no significant difference (p = 1.00).

No adverse effects were observed in any horse related to control or test treatments during the conduct of the study. There was no difference in the treatment sessions for the horses that did not show improvement, in R1 (2 test horses) and R2 (1 test horse) measurements. There was no attempt to determine the reason for cervical stiffness in study horses, therefore, the non-response remains undetermined.

DISCUSSION

This randomized, blinded, controlled study investigated the effectiveness of acupuncture treatment to lessen cervical pain and stiffness in horses, through the analysis of neck movement measurements and muscle mass changes from 18 horses. Study findings demonstrated there was statistically significant improvement in degree of lateral bend in the acupuncture

Table 2: Summary statistics (mean ± SD) for study horse signalment.

	Test Group	Control Group	*p*-value
Age (Years)	14.32 ± 2.32	14.67 ± 1.89	0.859
Gender (% of Mare)	22%	33%	1.00
Breed (% of Thoroughbred, Warmblood)	(44%; 56%)	(44%; 33%)	1.00*
Main Activity/Use (% Jumpers)	44%	44%	1.00

*Proportion comparison with respect to Thoroughbred breed

Table 3: Summary of statistically significant Test Group study findings.

	R1 Mean Degrees Improved	*p*-value		R2 Mean Degrees Improved	*p*-value
Test Group Acupuncture	9.83 ±8.87	p=0.025*		12.22 ±8.82	p=0.008**
Control Group Sham Acupuncture	-6.83 ±15.26	p=0.301		-5.17 ±13.07	p=0.301
Comparison Test versus Control	Test Group > Control	p=0.019*		Test Group > Control	p=0.008**

Statistically significant value *p <0.05 or ** p< 0.01

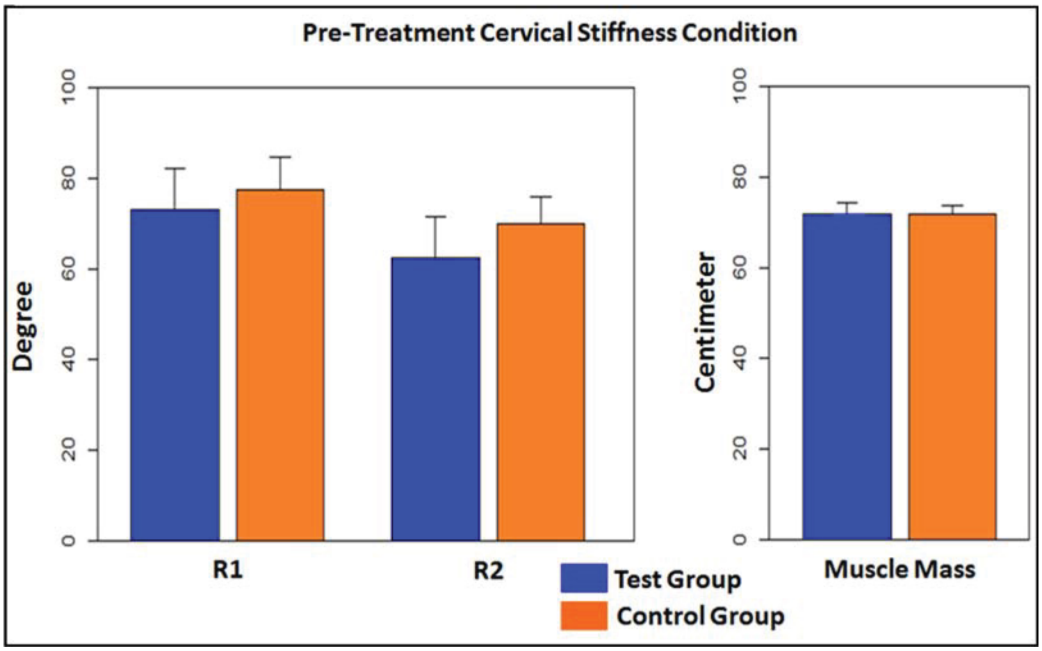


Figure 6: Comparison of mean pre-treatment outcome measurements between the Test Group and Control Group. There was no statistically significant difference between test and control groups for R1 (p=0.860), R2 (p=0.724) or muscle mass (p=0.377) at study start.

group when compared to the sham-acupuncture group. This finding was consistent for both R1 maximal bend (p = 0.025) and R2 pre-compensation (p = 0.008). These findings support the study hypothesis that acupuncture can improve cervical stiffness in horses.

Acupuncture has been used to treat neck pain and stiffness in humans with good effect, and the same was seen in this study.[30,31] It has also been studied for the treatment of osteoarthritis in several species.[4,27,31,32] It is interesting to note that one horse in the Test Group of this study was known to have severe osteoarthritis and degenerative changes to the facets in the lower cervical region. When evaluated on the day after the third acupuncture session, this horse had an improved lateral bend of 20 degrees for the R1 measurement and 29 degrees for R2 (left and right combined). In an evaluation of cervical spinal cord disease in dogs, Liu et al. found good treatment efficacy in a retrospective study investigating the clinical use of acupuncture and herbal medicine.[26] Similar to the current study, electro-acupuncture was used, however, it was only used to treat the most severely affected dogs and the treatment groups were small. The use of EAP both in the canine study and current study is supported by literature as it has been shown to block pain.[5,33]

An unexpected finding in this study was the improvement in lateral neck bend without an associated muscle mass change. It is expected and seen clinically that with treatment an increased muscle mass can be seen in 30 days; therefore, it was hypothesized that as lateral bend improved, muscle mass would increase as well. This was, however, not supported by study findings. Muscle atrophy due to neck pain has not been proven in horses as it has in humans with neck pain; but seems plausible.[12]

The difficulty proving this in the current study has several possibilities: 1) neuromuscular training may be needed in addition to pain relief to affect a change 2) the method of muscle measurement was inadequate and 3) a longer post-treatment time period is necessary to see significant muscle change.

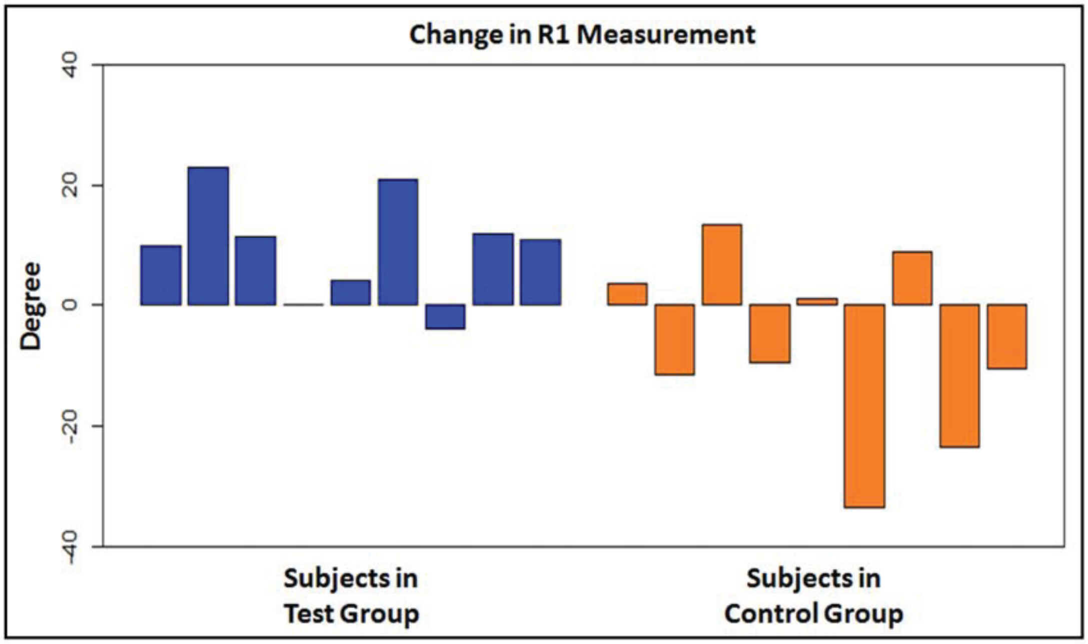


Figure 7: Change of R1 measurement in each study subject from pre-study assessment to 1 day after receiving the third acupuncture treatment (increasing bar equals greater lateral flexibility). The test subjects had 7 of 9 horses with improved maximal bend degree (mean change = 9.83 degrees) while the control subjects had 4 of 9 horses with improved maximal bend degree (mean change = -6.83 degrees).

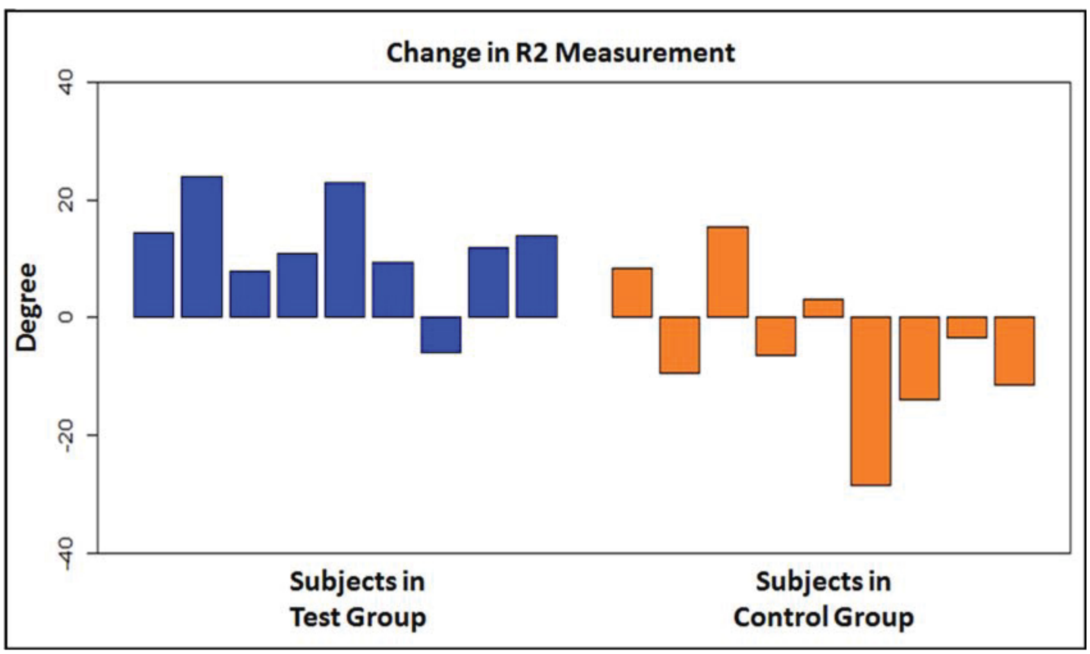


Figure 8: Change of R2 measurement in each study subject from a pre-study assessment to 1 day after receiving the third acupuncture treatment (increasing bar equals greater lateral flexibility). The test subjects had 8 of 9 horses with improved maximal bend degree (mean change = 12.22 degrees) while the control subjects had 3 of 9 horses with improved maximal bend degree (mean change = -5.17 degrees).

Considering neuromuscular training, abnormal recruitment and timing of activation of the cervical muscles is seen with chronic neck pain and there are recommendations to treat this with specific exercises. Similar to this, altered recruitment patterns remain in humans with low back pain even after the pain has resolved.[30] It is possible that specific exercises are needed to re-train the neuromuscular system to regain muscle mass in equines as well. Considering muscle measurement variability in this study, a flex curve was used to determine the width of the neck at two cervical levels and measurements were taken at two sites at each level. The position of the horse's neck and muscle tension could have influenced the muscle mass measurement. The horses were allowed to have their necks in a natural position for this measurement, however, future studies may benefit from having a strict standardized neck position for this measurement. More precise measurements might also be possible using ultrasonography. It could be used to measure the cross-sectional diameter of specific muscles rather than an external measurement of the width of the neck as in the current study.

There is some debate about using sham acupuncture as a control. It is unlikely that any form of sham acupuncture is completely inert.[33-35] The most commonly used sham treatments are true acupuncture points that are not indicated for the condition being treated, non-acupuncture points, and superficial needle insertion. The concern is that sham acupuncture has some effects and that the effectiveness of the verum treatment may be underestimated. In this study sham acupuncture was used at non-acupuncture points with very superficial needles. In the Control Group 4/9 horses showed some improvement in R1 and 3/9 showed some improvement in R2, suggesting that the sham treatment may have had some effect. The inclusion of a third group that received no treatment would have been beneficial. Finally, there was no attempt to determine the reason for cervical stiffness in study horses. Future studies with greater numbers could examine the effect of acupuncture on horses with functional versus structural change.

In summary, findings from this study demonstrated that 3 sessions of electro-acupuncture treatment (10 minutes, 20 Hz) spaced 7-10 days apart can significantly improve lateral neck bend in horses with cervical stiffness. There were no adverse effects from experimental or control treatments in any study horse. The duration of effect was not evaluated in this study; therefore it is unknown, and treatment may need to be repeated to maintain improvement. Based on the results of this study acupuncture is an effective treatment for cervical stiffness and can be used as the sole treatment. The effectiveness may be increased if acupuncture is combined with manual therapy, manipulation, specific cervical exercises or facet injections. In the future, larger, blinded prospective studies with a negative control group are needed to validate the results of this small study that demonstrated very encouraging results with acupuncture for the treatment of equine cervical stiffness.

ACKNOWLEDGEMENTS

Declaration of Interest

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

Funding

The author did not receive any specific grant of funding from any organization in the public, commercial or non-profit sectors.

FOOTNOTES

[a] Randomization.com (http://www.randomization.com)
[b] Millennia sterile acupuncture needles, UPC Medical Supplies Inc, San Gabriel, CA, USA
[c] Electro-acupuncture stimulator, Cefco, Oklahoma, USA
[d] Seirin Pyonex singles, Seirin America Inc, Weymouth, MA, USA
[e] iPad Pro, Apple Inc, Cupertino, CA, USA
[f] Coach's Eye-Video Analysis for iPad, TechSmith Corporation, Okemos, MI, USA
[g] Flex Curve, Staedtler Mars North America, Mississauga, Ontario, Canada
[h] R Version 3.5.2., The R Foundation for Statistical Computing, Vienna, Austria

REFERENCES

1. Dyson S. Lesions of the equine neck resulting in lameness or poor performance. Vet Clin North Am Equine Pract 2011; 27(3): 417-37.
2. Hutchinson A, Ball S, Andrews J et al. The effectiveness of acupuncture in treating chronic non-specific low back pain: a systematic review of the literature. J Orthop Surg Res 2012; 7:36. doi: 10.1186/1749-799X-7-36
3. Lane D, Hill S. Effectiveness of combined acupuncture and manual therapy relative to no treatment for canine musculoskeletal pain. Can Vet J 2016; 57(4): 407-414.
4. Zhang Y, Bao F, Wang Y et al. Influence of acupuncture in treatment of knee osteoarthritis and cartilage repairing. Amer J Trans Res 2016; 8(9): 3995-4002.
5. Lau W, Lau Y, Zhang H et al. Electroacupuncture versus celecoxib for neuropathic pain in rat SNL model. Neurosci 2010; 170(2): 655-61.
6. Nabeta T, Kawakita K. Relief of chronic neck and shoulder pain by manual acupuncture to tender points – a sham controlled randomized trial. Comp Ther Med 2002; 10(4): 217-222.

7. Zsoldos R, Licka T. The equine neck and its function during movement and locomotion. Zoology 2015; 118(5): 364-376.
8. Waldern N, Wiestner T, von Peinen K et al. Influence of different head-neck positions on vertical ground reaction forces, linear and time parameters in the unridden horse walking and trotting on a treadmill. Eq Vet J 2009; 41(3): 268-273.
9. Buchner H, Obermuller S, Scheidl M. Body centre of mass movement in the lame horse. Equine Vet J Suppl 2001; 33(33): 122-7.
10. Buchner H, Savelberg H, Schamhardt H et al. Head and trunk movement adaptations in horses with experimentally induced fore- or hind limb lameness. Eq Vet J 1996; 28(1):71-76.
11. Vorstenbosch M, Buchner H, Savelberg H et al. Modeling study of compensatory head movements in lame horses. Am J Vet Res 1997; 58(7): 713-8.
12. Fernandez-de-las-Penas C, Albert-Sanchis J, Buil M et al. Cross-sectional area of cervical multifidus muscle in females with chronic bilateral neck pain compared to controls. J Orthop Sports Phyd Ther 2008; 38(4): 175-80.
13. Gizzi L, Muceli S, Petke F et al. Experimental pain impairs synergistic modular control of neck muscles. PLos One 2015; 10(9): e0137844.
14. Lindstrom R, Shomacher J, Farina D et al. Association between neck muscle co-activation, pain and strength in women with neck pain. Man Ther 2011; 16(1): 80-6.
15. Falla D, Bilenkij G, Jull G. Patients with chronic neck pain demonstrate altered patterns of muscle activation during performance of a functional upper limb task. Spine 2004; 29(13): 1436-40.
16. Stubbs N, Riggs C, Hodges P et al. Osseous spinal pathology and epaxial muscle ultrasonography in Thoroughbred racehorses. Eq Vet J Suppl 2010; (38): 654-61.
17. Cagnie B, O'Leary S, Elliot J et al. Pain induced changes in the activity of the cervical extensor muscles evaluated by muscle functional magnetic resonance imaging. Clin J Pain 2011; 27(5): 392-7.
18. Falla D, Rainoldi A, Merletti R et al. Myoelectric manifestations of sternocleidomastoid and anterior scalene muscle fatigue in chronic neck pain patients. Clin Neurophysiol 2003; 114(3): 488-95.
19. Xie J, Chen Z, Guo W et al. Efficacy observation of cervical spondylosis treated with acupuncture at three lines of cervical Jiaji (EX-B 2), Zhongguo Zhen Jiu 2014 ; 34(9): 863-6.
20. Cameron I, Wang E, Sindhusake D. A randomized trial comparing acupuncture and simulated acupuncture for subacute and chronic whiplash.Spine 2011; 36(26): 1659-65.
21. Kwon H, Choi J, Lee M et al. Acupuncture for the sequelae of Bell's palsy: a randomized controlled trial. Trials 2015; 16: 246.
22. Zhang R, Lao L, Ren K et al. Mechanisms of acupuncture-electroacupuncture on persistent pain. Anesthesiology 2014; 120(2): 482-503.
23. dos Santos de Almeida M, Moura de Freitas K, Oliviera L et al. Acupuncture increases the diameter and reorganization of collagen fibrils during rat tendon healing. Acupuncture Medicine 2015; 33(1): 51-7.
24. Fan Y, Wu Y. Effect of electroacupuncture on muscle state and infrared theromogram changes in patients with acute lumbar muscle sprain. J Tradit Chin Med 2015; 35(5): 499-506.
25. Xie H, Preast V. Traditional Chinese Veterinary Medicine: Fundamental Principles (Volume 1). Reddick, FL: Jing-Tang Publishing 2002: 519-22.
26. Liu C, Chang F, Lin C. Retrospective study of the clinical effects of acupuncture on cervical neurologic disease in dogs. J Vet Sci 2016; 17(3): 337-45.
27. Magden E, Haller R, Thiele E et al. Acupuncture as an adjunct therapy for osteoarthritis in chimpanzees. Journal of American Assoc of Lab Animal Science 2013; 52(4): 475-80.
28. Stewart R, Reed S, Weisbrode S. Frequency and severity of osteochondrosis in horses with cervical stenotic myelopathy. Amer J Vet Res 1991; 52(6): 873-9.
29. Xie H, Rimar T. Effect of a combination of acupuncture and herbal medicine on wobbler syndrome in dogs and horses. Traditional Chinese Veterinary Medicine: Empirical Techniques to Scientific Validation. Reddick, FL: Jing Tang Publishing 2010: 101-112.
30. Moreside J, Quirk D, Hubley-Kozey C. Temporal patterns of the trunk muscles remain altered in a low back-injured population despite subjective reports of recovery. Arch Phys Med Rehabil 2014; 95(4): 686-98.
31. Fu W, Liang Z, Zhu X et al. Analysis of effect of acupuncture in treating cervical spondylosis with different syndrome types. Chin J Integr Med 2009; 15(6): 426-30.
32. Seo B, Park D, Baek Y. The analgesic effect of electroacupuncture on inflammatory pain in the rat model of collagenase-induced arthritis: mediation by opiodergic receptors. Rheumatology International 2013; 33(5): 1177-83.
33. Pearson K, Gordon J. Spinal reflexes. Principles of Neural Science 4th Ed, Kandel E (ed). New York, NY: McGraw Hill 2000: 713-736.
34. Wang Z, Perez-Terzic C, Smith J et al. Efficacy of intervertebral disc regeneration with stem cells – a systematic review and meta-analysis of animal controlled trials. Gene 2015; 564(1):1-8.
35. Brehm W, Burk J, Delling U. Application of stem cells for the treatment of joint disease in horses. Methods Mol Biol 2014; 1213:215-28. doi: 10.1007/978-1-4939-1453-1_18.