Journal of Equine Veterinary Science 56 (2017) 80–87

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Case Report

# Equine Performance and Autonomic Nervous System Improvement After Joint Manipulation: A Case Study

Erin K. McQueen, Sarah E. Urban, Mike T. McQueen*

*McQueen Animal Chiropractic and Research Institute, Washington, MO*

ARTICLE INFO

*Article history:*
Received 15 February 2017
Received in revised form 14 April 2017
Accepted 25 April 2017
Available online 11 May 2017

*Keywords:*
Equine chiropractic
Equine thermography
Animal chiropractic

ABSTRACT

A nine-year-old gelding quarter horse, whose discipline is barrel racing, was experiencing difficulty performing tight turns around the barrels for 8 months prior to treatment. He demonstrated tail swishing as if aggravated when under the saddle, which would escalate to bucking for 3 weeks prior to treatment. This gelding had no previous history of bucking under the saddle. Static and motion palpation findings indicated multiple segmental joint fixations located throughout the spine and extremities. High-velocity low-amplitude adjustments were performed to address the joint fixations found during examination. A comparison of pre and post-treatment thermographic images showed a temperature change indicative of autonomic nervous system improvement caused by joint manipulation. A follow-up at two weeks revealed subjective long term improvements. Subjective, objective, and thermographic evidence indicated that segmental joint dysfunction was causing increased nociception and autonomic dysregulation, most notably over the sacroiliac joints, lateral front left cannon bone and right carpus. Previous research has indicated causative effects of joint manipulation on the autonomic nervous system and nociceptive processes. This case shows the positive thermographic effects post-adjustment on the nervous system, and a two week follow-up indicated that the gelding no longer showed signs or symptoms of pain. This case demonstrates how joint manipulation can affect the autonomic and nociceptive nervous systems in the equine patient.



## 1. Introduction

According to the American Veterinary Chiropractic Association, “Over 1,100 animal chiropractic professionals have been certified since 1989” [1], yet the effects of equine joint manipulation on the autonomic nervous system, joint dysfunction, and performance are not well documented. Although there have been many articles and stories citing the benefit of animal chiropractic, there remains a lack of scientific research on the area [2]. Chiropractic in terms of treating people has a long established history and an ever improving research foundation supporting its use, but this foundation is lacking in equine chiropractic [3]. Equine chiropractic is a critical practice when attempting to identify the primary cause of lameness or poor performance caused by vertebral joint dysfunction and neuromusculoskeletal

This information has not been presented outside the confines of McQueen Animal Chiropractic and Research Institute and the JEVS.

*Animal care and welfare statement:* All procedures were approved by the McQueen Animal Chiropractic and Research Institute (MACARI) Institutional Animal Care and Use Committee (IACUC).

*Ethical approval statement:* In regards to research on animals, this study was conducted and coordinated within the guidelines and policies of the Animal Welfare Act (AWA) enforced by the United States Department of Agriculture (USDA).

*Conflict of interest statement:* No third-party funding or support was received in connection with this study or the writing or publication of the manuscript. Funding sources did not have any involvement in the study design, data analysis, and interpretation, or writing and publication of the manuscript. Informed consent was obtained before treatment. The authors declare that there were no conflicts of interest.

* Corresponding author at: Mike T. McQueen, 1351 Jefferson Street, Washington, MO 63090.

*E-mail address:* drmikemcqueen@gmail.com (M.T. McQueen).

0737-0806/$ – see front matter © 2017 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jevs.2017.04.012

disorders; the lack of research only hinders our ability to properly implement this practice [4].

Given the current advancement in thermographic technology, we are better able to document the effects of joint manipulation than ever before. To contribute scientific knowledge to the growing field of animal chiropractic, we formulated a hypothesis that segmental joint dysfunction identified by performance history, visual examination, static and motion palpation, spinal reflexes, and autonomic dysfunction present on thermography treated with joint manipulation will improve performance and autonomic dysfunction visible on posttreatment thermography.

The purpose of this case study is to show that equine pain and performance issues caused by segmental joint dysfunction can be resolved by joint manipulation. To objectively document this effect, we used thermography before and after treatment. Thermography is an ideal objective instrument because joint dysfunction affects the autonomic nervous system and the autonomic nervous system controls blood flow [2,5–12]. This case study is important because there is currently a lack of research that provides objective quantitative and qualitative data that support joint manipulation effects on the equine patient.

**Table 1**
Location and restricted planes of motion of segmental dysfunctions.

| Location | Motion Restricted in the Following Planes |
|---|---|
| C1 vertebra | Dorsal to ventral and cranial to caudal on left |
| C3 vertebra | Rotation from right to left and dorsal to ventral |
| C4 vertebra | Rotation from right to left |
| C5 vertebra | Rotation from left to right |
| C6 vertebra | Rotation from left to right |
| T4 vertebra | Rotation from left to right |
| T5 vertebra | Rotation from right to left |
| T6 vertebra | Rotation from right to left |
| T14 vertebra | Rotation from right to left and dorsal to ventral |
| T15 vertebra | Rotation from right to left and dorsal to ventral |
| T16 vertebra | Rotation from right to left and dorsal to ventral |
| T17 vertebra | Rotation from left to right and dorsal to ventral |
| T18 vertebra | Rotation from left to right and dorsal to ventral |
| L1 vertebra | Rotation from left to right and dorsal to ventral |
| L3 vertebra | Rotation from right to left and dorsal to ventral |
| L5 vertebra | Rotation from right to left and dorsal to ventral |
| Left sacroiliac joint | Dorsal to ventral |
| Right sacroiliac joint | Ventral to dorsal |
| Sacral base | Dorsal to ventral on right |
| Sternum | Left to right |
| Right T13 rib | Dorsal to ventral |
| Left T13 rib | Dorsal to ventral and caudal to cranial |
| Left T14 rib | Dorsal to ventral and cranial to caudal |
| Left glenohumeral | Rotation from internal to external |
| Right distal femur | Rotation from lateral to medial |
| Left distal femur | Rotation from lateral to medial |
| Left proximal tibia | Rotation from medial to lateral |
| Right calcaneus | Rotation from lateral to medial |
| Left calcaneus | Rotation from lateral to medial |

## 2. Clinical Findings

The patient was a 9-year-old gelding Quarter Horse, with a weight around 1,300 lbs, whose discipline was barrel racing. Eight months before treatment, he experienced difficultly when attempting to make tight turns around the barrels. Three weeks before treatment, he demonstrated tail swishing as if aggravated when under the saddle, which escalated to bucking. This gelding had no previous history of bucking under the saddle. Visual inspection was normal. Pretreatment thermographic images were taken using the Veterinarian Guidelines for Infrared Thermography set by the American Academy of Thermography [5]. The principle investigator used a FLIR 420bx (infrared camera, Wilsonville, OR) thermographic camera which is capable of a resolution of 640 × 480 pixels with software enhancement. Camera distance from the gelding when taking photographs were taken was 8 feet, and the gelding was located in a barn with no moving air present for greater than 2 hours before treatment; the environment was otherwise controlled. Previous research on static palpation has indicated that the palpation of painful areas has a higher degree of interexaminer and intraexaminer reliability than the palpation for landmarks [6]. Here, static palpation produced palpatory tenderness over the left sacroiliac (SI) joint and over the thoracolumbar junction bilaterally with mild severity. On testing the paraspinal reflexes, it was noted that they were absent bilaterally. Upon motion palpation of the gelding's joints, the following fixations and corresponding restricted plane of motion were noted in Table 1.

## 3. Treatment and Outcome

The gelding received treatment in the form of spinal and extra-spinal manual high-velocity low-amplitude adjustments to correct the joint fixations noted on examination. High-velocity low-amplitude adjustments or manipulations have been previous defined as a high-speed low-force thrust in the plane of a joint when that joint is at its physiological end range [7]. Posttreatment thermographic images were taken 20 minutes after treatment, and the gelding remained calm and in the temperature controlled environment per the Veterinarian Guidelines for Infrared Thermography set by the American Academy of Thermography [5]. After 2 weeks, a follow-up on the geldings previous subjective issues revealed that he was no longer bucking or swishing his tail in aggravation while under the saddle. His barrel turns were normal, and the owner stated that his lead changes became quicker and his trot and lope were smoother then before he was symptomatic.

## 4. Clinical Relevance

The connection between subjective and objective improvement after joint manipulation in the equine model is difficult to document. However, thermography is a

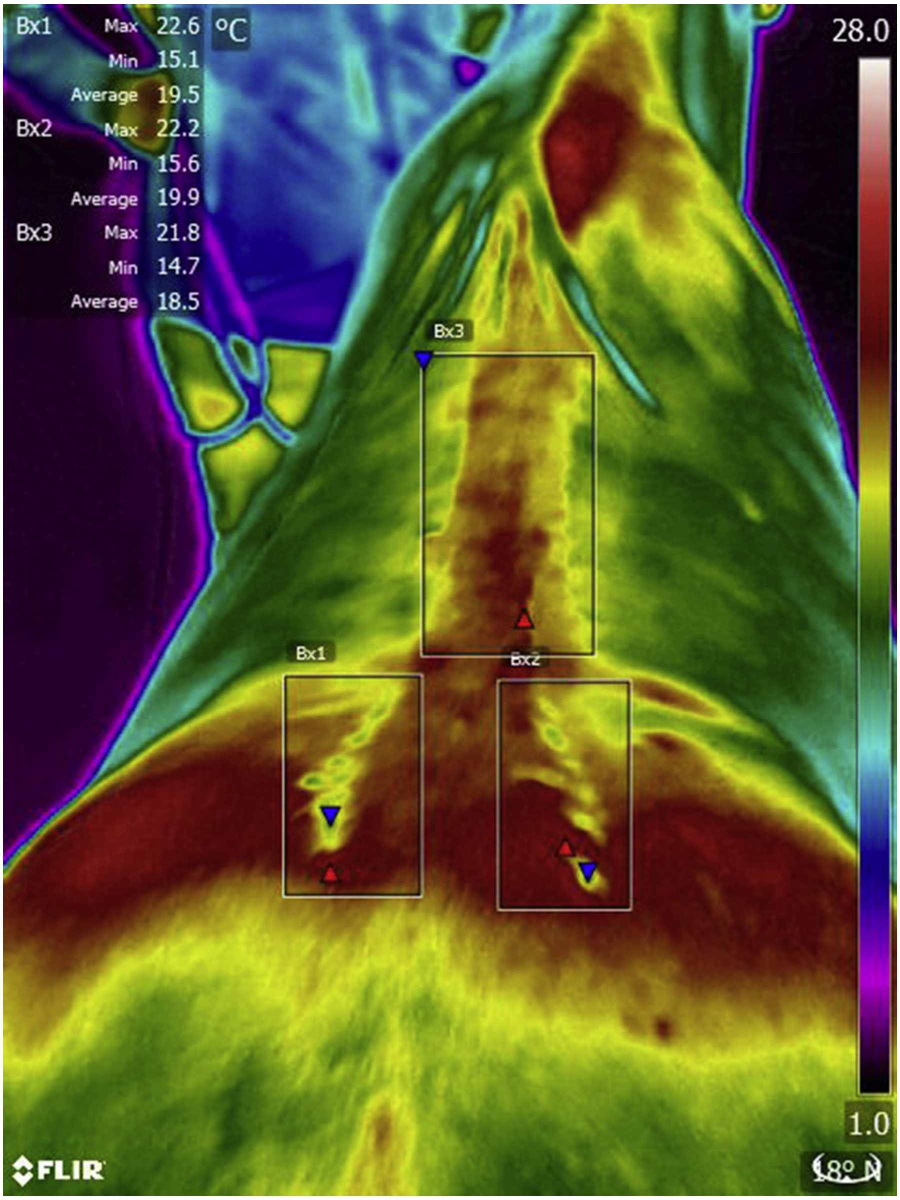


**Fig. 1.** Pre-treatment dorsal thermographic image.

quantitative and qualitative noninvasive objective measure that has been shown to be repeatable and reliable [8]. In this case, thermography helps to demonstrate a causative relationship among joint manipulation, performance, and the autonomic nervous system. It has been well documented that joint manipulation can affect the autonomic nervous system [5,8]. Previous research has indicated that an autonomic nervous system dysfunction can be objectively observed using thermography [2,9–11,13]. This nerve dysfunction can be seen on thermographic images by locating hypothermic areas though the assessment of asymmetrical temperature distributions, well-defined borders of temperature difference, and a temperature difference from the surrounding area by at least 1°C [5].

Interesting to this case is that Von Schweinitz [14] stated that "Chronic pain syndromes often involve persistent increased sympathetic nervous tone causing regionalized hypothermia from vasoconstriction." This case reveals a unique thermographic presentation consisting of bilateral SI joints, lateral front left cannon bone, and lateral and medial right carpus joint hypothermic vasogenic changes caused by their associated joint dysfunction; this is best seen in Figs. 1–3, respectively. Due to the highly specific temperature differences in very short distances over the SI joints (Fig. 1), comparing minimum pretreatment and posttreatment temperatures gives a better representation of the effects the treatment had rather than observing average or maximum temperature changes pretreatment

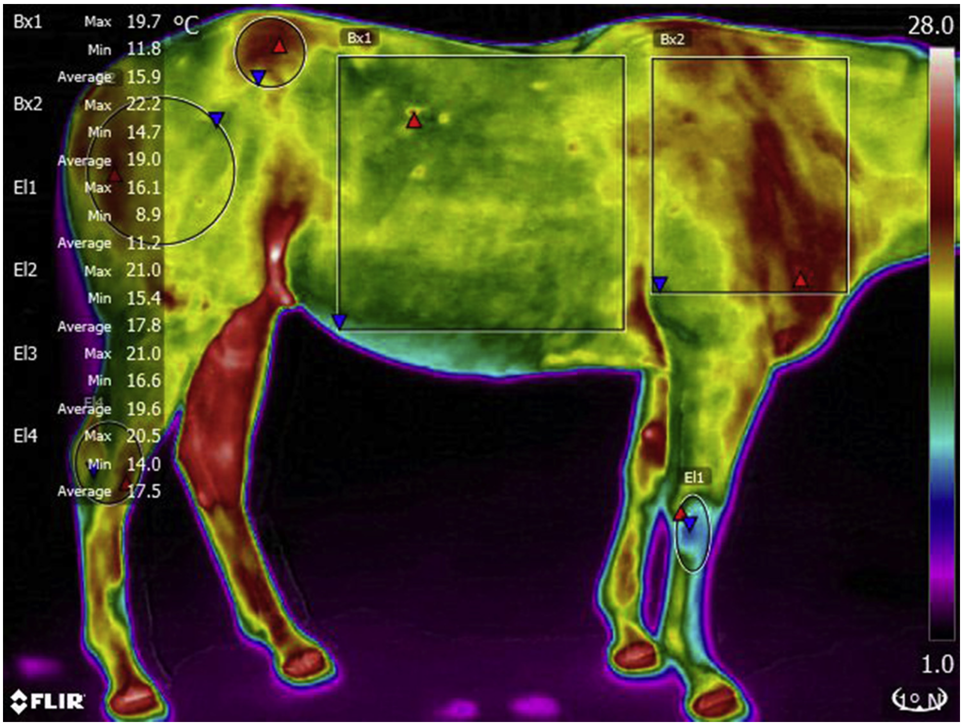


**Fig. 2.** Pre-treatment right lateral thermographic image.

and posttreatment. As Fig. 4 depicts, minimum temperature changes pretreatment and posttreatment over the right and left SI joints were 2.6°C and 1.9°C, respectively. Here, we see greater than the required minimum of 1°C change necessary to indicate a vasogenic change. Assessment of the lateral right carpus can be best analyzed by the

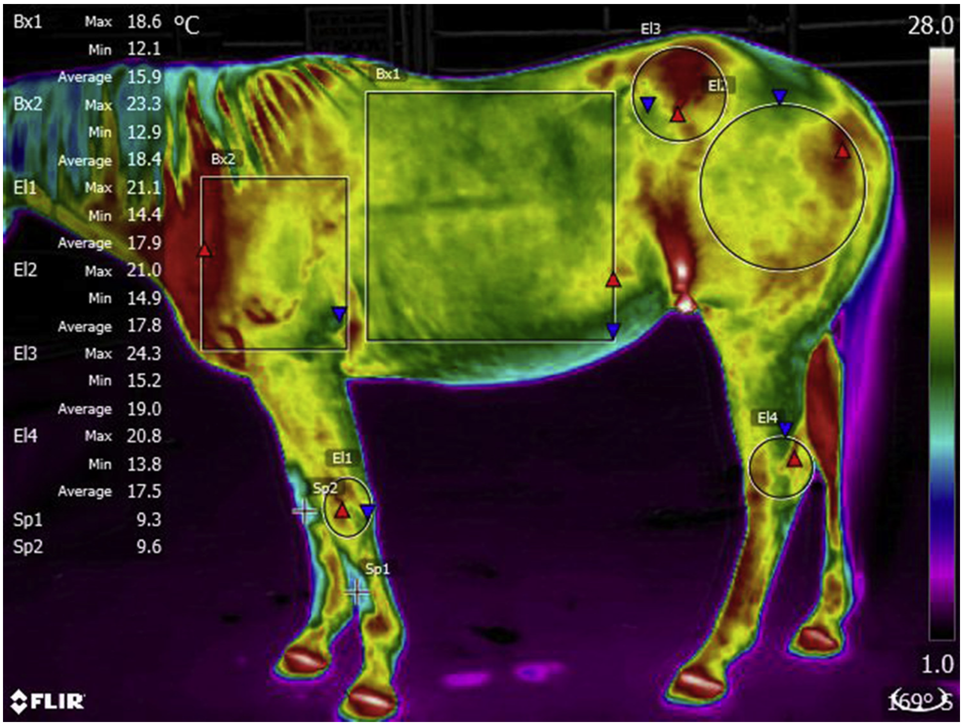


**Fig. 3.** Pre-treatment left lateral thermographic image.

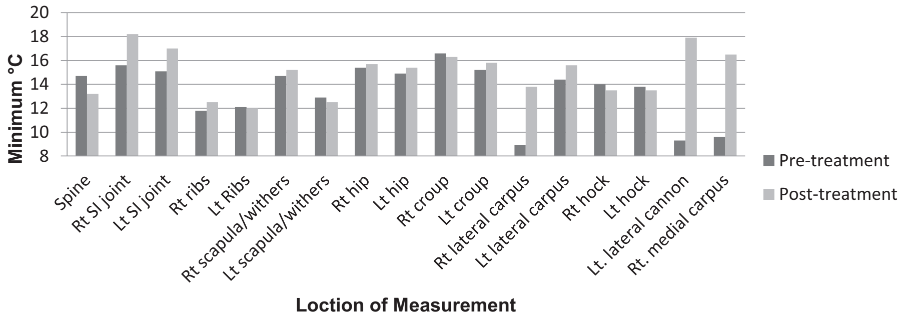


**Fig. 4.** Minimum measured temperatures within the areas of interest.

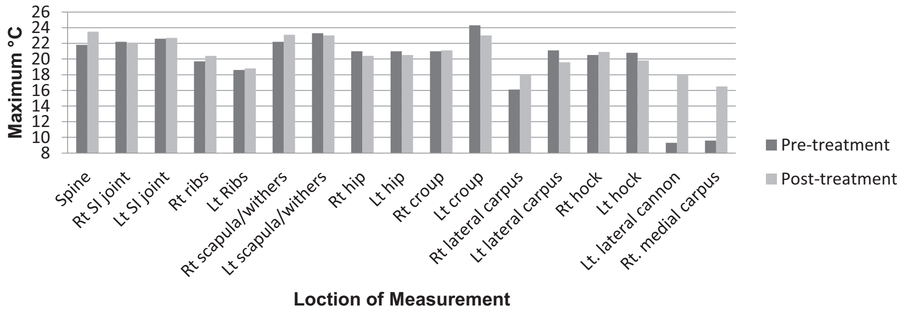


**Fig. 5.** Maximum measured temperatures within the areas of interest.

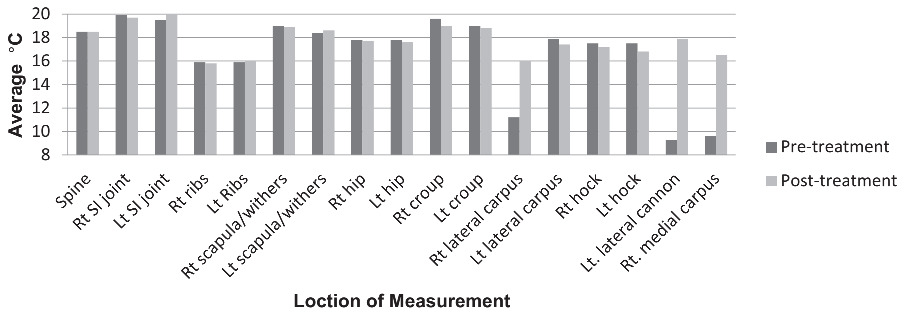


**Fig. 6.** Average measured temperatures within the areas of interest.

difference in minimum, maximum, and average temperatures pretreatment and posttreatment (Figs. 4–6). Average temperature readings indicate that the lateral right and left carpus increased 3.8°C and decreased 0.5°C, respectively, after treatment. The right carpus not only had a large change in temperature pretreatment and posttreatment, but the change in right to left, sagittal asymmetry, from pretreatment to posttreatment as measured with average temperature readings dropped from 6.7°C to 1.4°C or 79%. Furthermore, if we assess the areas over the medial right carpus and lateral front left cannon bone, we see spot temperature changes pretreatment and posttreatment of 6.9°C and 8.6°C, respectively. This would suggest that joint manipulation alone was responsible for a significant decrease in temperature asymmetries and therefore nociceptive neurologic signals from fixated joints responsible for pretreatment painful static and motion palpation and aberrant subjective behavior. A paired two-tailed $t$-test was run on 5 minimum temperature values over the areas of interest (bilateral SI joints, lateral front left cannon bone, and lateral and medial right carpus joint) to determine whether there was a statistically significant mean difference between the pretreatment hypothermic areas when compared to the posttreatment hypothermic areas. These hypothermic areas identified on pretreatment thermography averaged $11.7 \pm 3.3$°C as opposed to the posttreatment hypothermic average of $16.7 \pm 1.7$°C; a statistically significant increase of 5.0°C was seen (95% confidence interval: $-8.489$ to $-1.471$), $t(4) = 3.9402$, $P < .05$, $d = 1.87$. Given the statistical significance of the increase in the minimum temperatures after adjustment, it is reasonable to conclude that the adjustment affected the autonomic

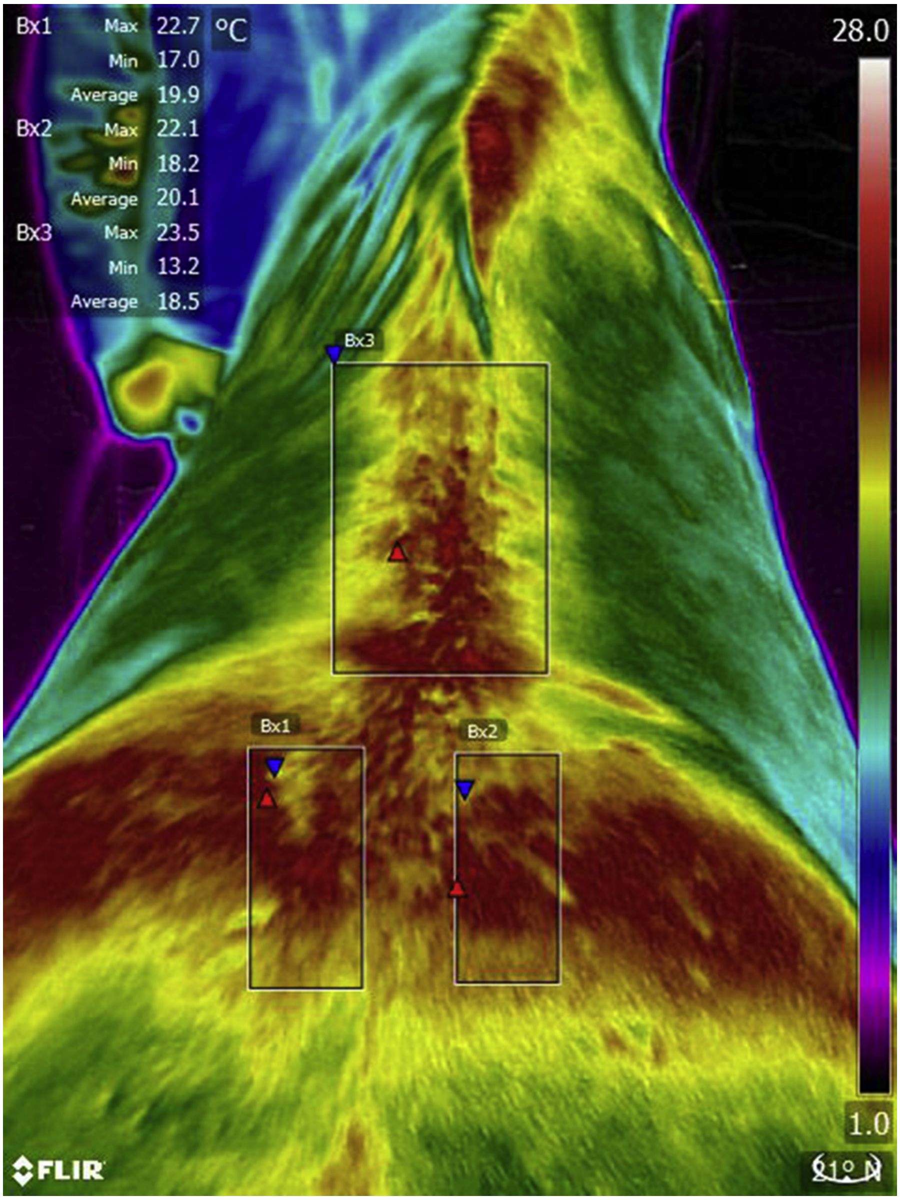


**Fig. 7.** Post-treatment dorsal thermographic image.

nervous system via mobilization of a fixated joint which manifested as an increase in temperature on posttreatment thermography. This change in temperature follows the reported mechanism that chronic pain has on the autonomic nervous system by Von Schweinitz [14]. As a practitioner, we can qualitatively assess the differences pretreatment and posttreatment by looking at the temperature linear color distribution of Figs. 1–3, 7–9. Temperature linear color distribution is defined by FLIR as "An image-displaying method where the color information in the image is distributed linearly to the temperature values of the pixels." [15] Confounding variables such as a dry hair coat; controlled environment with no direct overhead lighting or ventilation; no use of medications or previous treatments within 24 hours; no red flags that would contradict care; no contact with saddle, blanket, or other materials within 20 minutes before imaging; no intense physical exertion 2 hours before imagining; and others were controlled for by following the Veterinarian Guidelines for Infrared Thermography set by the American Academy of Thermography [5]. To add further support to our conclusion, we attempted to create an intrastudy control group to help identify other possible confounding variables that could have affected the gelding's surface temperature. We analyzed large areas of the gelding's body pretreatment and posttreatment to see how much the gelding's whole body temperature had changed as a result of treatment (Figs. 1–3, 7–9). When we average all 15 different areas

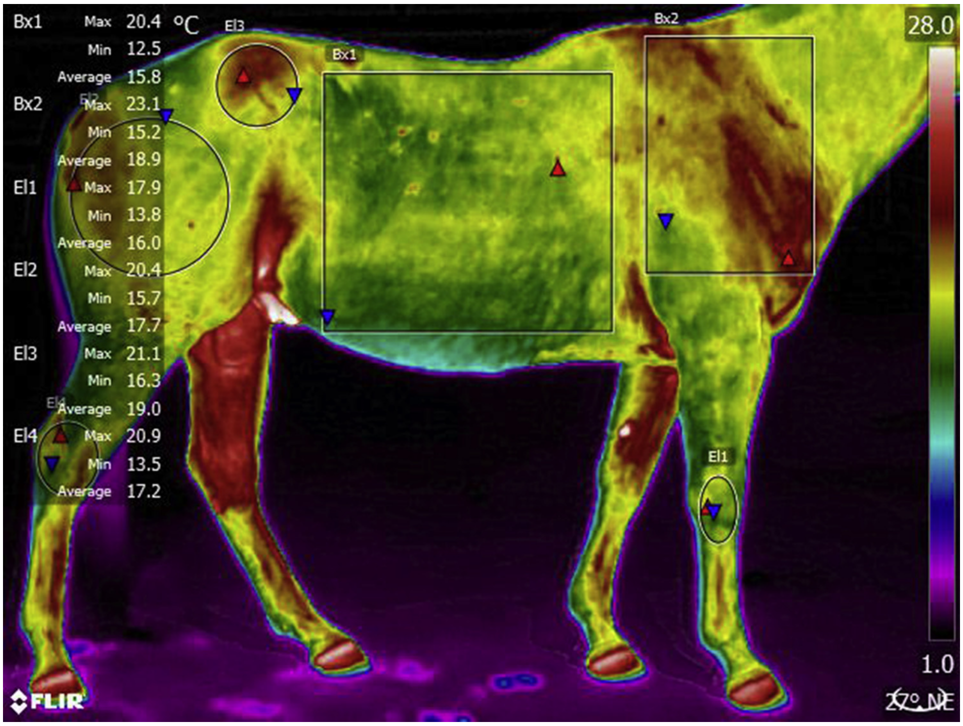


**Fig. 8.** Post-treatment right lateral thermographic image.

pretreatment and posttreatment, the difference is an overall decrease of 0.2°C. Furthermore, if we remove our regions of interest, the difference is an overall decrease of 0.1°C. This would lead us to believe that possible confounding variables, such as environment or muscle activity, had a negligible effect in the time between images. Other

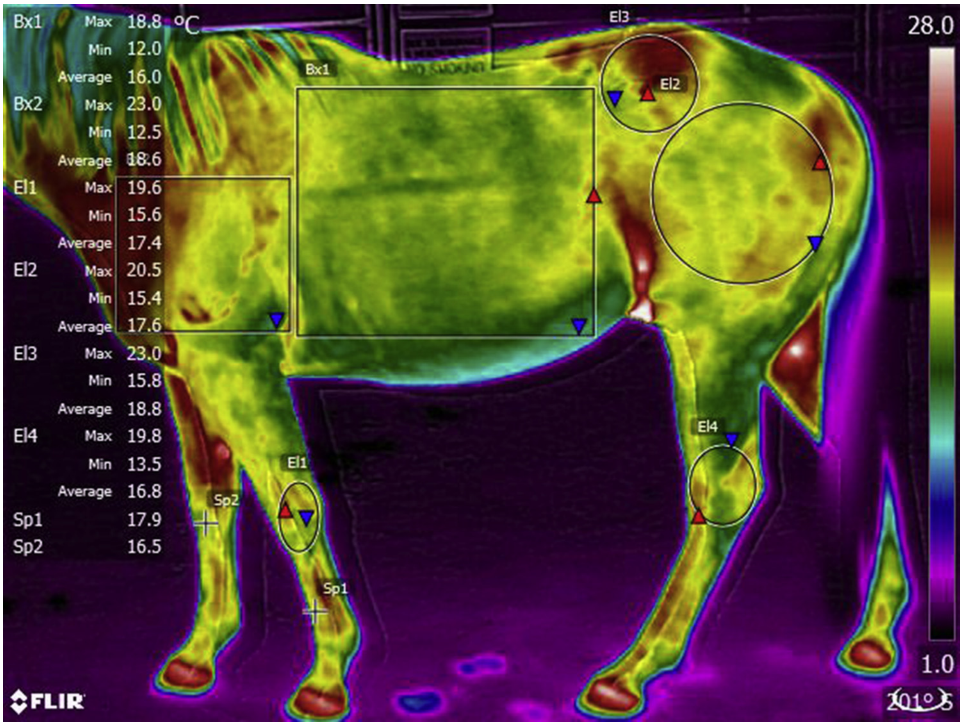


**Fig. 9.** Post-treatment left lateral thermographic image.

possible variables would be the angles the pictures were taken at pretreatment and posttreatment and the size of the sample boxes used to assess temperatures in the FLIR Tools/Tools + program (Wilsonville, OR).

## 5. Conclusion

In conclusion, prethermographic and postthermographic images indicate a significant change in the autonomic nervous system after joint manipulation of the joint fixations found using the gelding's static and motion palpation findings. This would suggest that this gelding's pain and performance issues were the direct result of joint fixations. A larger study that could implement statistical analysis is warranted to address the effects of joint manipulation on joint dysfunction using thermography as an objective measure.

## Acknowledgments

No third-party funding or support was received in connection with this study or the writing or publication of the manuscript. Funding sources did not have any involvement in the study design, data analysis and interpretation, or writing and publication of the manuscript. Informed consent was obtained before treatment. This study was done in compliance of the Animal Welfare Act (AWA). This study has the oversight of an Institutional Animal Care and Use Committee (IACUC). The authors declare that there were no conflicts of interest. Special thanks to Kelli Greenwald, MS, for her technical contributions.

## References

[1] American Veterinary Chiropractic Association–Chiropractic, Spinal., American Veterinary chiropractic association–chiropractic, Spinal., N.p., n.d. Web. 23 Jan. 2017.
[2] Powell A. Research on animal chiropractic, www.animalchiropractic.us/chiropractic-research/researchpapers. Accessed January 23, 2017.
[3] Haussler KK. The role of manual therapies in equine pain management. Vet Clin North Am Equine Pract 2010;26:579–601.
[4] Haussler KK. Back problems. Chiropractic evaluation and management. Vet Clin North Am Equine Pract 1999;15:195–209.
[5] Veterinary Guidelines for infrared thermography. AAThermology. N. p., 2016. Web. 20 Jan. 2017.
[6] Haneline MT, Young M. A review of intraexaminer and interexaminer reliability of static spinal palpation: a literature synthesis. J Manipulative Physiol Ther 2009;32:379–86.
[7] Fernández-de-las-Peñas C, Downey C, Miangolarra-Page JC. Immediate changes in radiographically determined lateral flexion range of motion following a single cervical HVLA manipulation in patients presenting with mechanical neck pain: a case series. Int J Osteopath Med 2005;8:139–45.
[8] Tunley BV, Henson FMD. Reliability and repeatability of thermographic examination and the normal thermographic image of the thoracolumbar region in the horse. Equine Vet J 2004;36:306–12; Graf von Schweinitz D. Thermographic diagnostics in equine back pain. Vet Clin North Am Equine Pract 1999;15:161–78.
[9] Parwar BL, et al. Horner's syndrome and dissection of the internal carotid artery after chiropractic manipulation of the neck. Am J Ophthalmol 2001;131:523–4.
[10] Pickar JG. Neurophysiological effects of spinal manipulation. Spine J 2002;2:357–71.
[11] Yanmaz LE, Okumus Z, Dogan E. Instrumentation of thermography and its applications in horses. J Anim Vet Adv 2007;6:858–62.
[12] Welch A, Boone R. Sympathetic and parasympathetic responses to specific diversified adjustments to chiropractic vertebral subluxations of the cervical and thoracic spine. J Chiropr Med 2008;7:86–93.
[13] Turner TA. Thermography as an aid to the clinical lameness evaluation. Vet Clin North Am Equine Pract 1991;7:311–38.
[14] Graf von Schweinitz D. Thermographic diagnostics in equine back pain. Vet Clin North Am Equine Pract 1999;15:161–78.
[15] Systems, Inc. FLIR. FLIR Tools software for PC and Mac. FLIR Tools Software for Mac and PC FLIR Systems. N.p., n.d. Web. 24 Jan. 2017.