Electroacupuncture in the Treatment of Chronic Lameness in Horses and Ponies: A Controlled Clinical Trial

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ABSTRACT

Electroacupuncture was used to treat lameness in horses and ponies with chronic laminitis (n = 10) or navicular disease (n = 10). A clinical trial was conducted with random allocation of equal numbers of animals to control and treatment groups. Acupuncture was performed three times per week for four consecutive weeks. The degree of lameness was assessed by 1) a grading scheme, 2) measurement of stride lengths and 3) analysis of weight distribution using a force plate. Although seven out of ten animals with chronic laminitis improved clinically during the trial, there were no statistically significant differences between treatment and control groups. Six out of ten horses with navicular disease improved, but there were no significant differences between treatment and control groups.

RÉSUMÉ

Cette expérience consistait à utiliser l'électroacupuncture, chez dix chevaux et poneys atteints de boiterie chronique, ainsi que chez dix chevaux qui souffraient de la maladie naviculaire. Les auteurs réalisèrent leur expérience en choisissant au hasard un nombre égal de sujets expérimentaux et de témoins. Ils utilisèrent l'acupuncture, trois fois par semaine, pendant quatre semaines, et ils déterminèrent la gravité de la boiterie, par les trois moyens suivants: 1) un schéma d'évaluation; 2) la mesure de la longueur des enjambées; 3) l'analyse de la répartition du poids, à l'aide d'un tapis enregistreur de pression. Même si sept des dix sujets atteints de boiterie chronique manifestèrent une certaine amélioration, au cours de l'expérience, on n'enregistra aucune différence statistique entre les sujets expérimentaux et les témoins. Six des dix chevaux qui souffraient de la maladie naviculaire manifestèrent aussi une certaine amélioration, mais on n'enregistra aucune différence significative entre les sujets expérimentaux et les témoins.

INTRODUCTION

The conclusion of the 1974 National Institutes of Health (NIH) Research Conference on Acupuncture was that the most valuable approaches to the study of acupuncture were in the areas of surgical anesthesia and chronic pain (1). Controlled clinical trials should be performed to avoid the indiscriminate use of acupuncture and to determine specific conditions where it may be indicated. Electroacupuncture and transcutaneous nerve stimulation have been beneficial to persons with chronic pain (2,3). Results of pilot studies (4-6) on lameness in horses support the view that further studies are warranted. The present study was conducted as a controlled clinical trial to determine whether acupuncture would bring about clinical improvement in horses and ponies with chronic laminitis or navicular disease.

MATERIALS AND METHODS

Ten horses and ponies with laminitis (Table I) and ten horses with navicular disease (Table II) were recruited based on the following criteria: 1) Presence of definitive signs of chronic laminitis/navicular disease in both front legs, as determined by gait evaluation, response to hoof testers, radiographic evidence of disease, and absence of lameness after diagnostic nerve blocks; 2) Lameness continuously present for at least two months to the best of the owner's knowledge; 3) No other major concurrent illness; 4) Age between 2 and 25 years; and 5) No drugs administered within two weeks prior to admission. Sex, body weight and breed were not considered.

Each animal was assigned randomly to a control/treatment group (n = 5/group). All horses and ponies were housed in concrete floored stalls, fed hay and grain, and exercised in a dirt paddock. Shoes, if present, were removed on admission. All animals had their hooves trimmed two weeks or longer before admission.

The day after admission, lameness was assessed 1) clinically, using a seven-point grading scheme (Tables III and IV), 2) by stride length measurements and 3) by force plate measurements. The three evaluations were usually made on the same day. The initial evaluations of stride length and force plate indices were repeated within three days to establish baseline (week 0) values.

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TABLE I. Signalment for Horses and Ponies with Laminitis

	Breed	Sex[a]	Age (years)	Duration of Lameness (years)
Control				
	Shetland X	M/C	15	3
	Welsh X	M/C	20	10
	Shetland X	F	6	2
	Shetland X	M/C	15	3
	Shetland X	F	25	15
Treated				
	Shetland X	M/C	10	2
	Shetland	F	13	3
	Appaloosa X	F	16	0.5
	Tennessee Walking Horse	M	9	2
	Shetland X	M/C	10	2

[a]F = female, M = male, M/C = castrated male

The clinical assessment was used to grade each front leg as the horse/pony walked straight ahead, and while it walked (in laminitis cases) or trotted (in navicular cases) in a circle to the left and right. All assessments were performed by one investigator who was unaware of whether the animal was in the control/treatment group. For analysis, the scores for both front legs during the various maneuvers were added to provide a single "clinical score."

Stride lengths were measured after walking the animal over a sand pit. The distance between the front edges of the imprint of each front leg was measured between successive strides. Five measurements were made to obtain the mean ± SD.

The force plate system has been described previously (7). Animals were led at a walk over a force plate which was mounted in a concrete walkway and concealed under carpet. Responses for the four legs were recorded with an FM magnetic tape recorder (Model 3964A, Hewlett-Packard, Palo Alto, California) for later analysis by a digital computer (Model PDP-12, Digital Equipment Corp, Maynard, Massachusetts) programmed to measure the maximal amplitude of the responses. The first five acceptable wave forms were used to obtain the mean ± SD for the maximal amplitude. A formula for rejection of outlying observations was applied, at the 95% confidence level, if a particular value appeared to be aberrant (8). The weight distribution (%) among the four legs was calculated from the maximal amplitude values by:

$$\frac{\text{Mean for one leg}}{\text{Summed mean for all legs}} \times 100$$

The normal weight distribution is 30% and 20% for the front and hind legs, respectively, with this equation (7). The absolute value by which each leg differed from these normal values was calculated and the four values were summed. This value was the "force plate index." Evaluation of all limbs was considered necessary since the lameness shifted in some horses.

Starting at week 1, electroacupuncture was administered for 20 min, three times per week for four consecutive weeks to animals in the treatment groups. Control animals had their hair clipped in a pattern identical to treated animals, but received no further therapy. All parameters were measured weekly. At the end of four weeks, a posterior digital nerve block (for navicular disease) or palmar nerve block at the level of the sesamoid bones (for laminitis) was performed, and stride length and force plate measurements, but not clinical assessments, were repeated for comparison of acupuncture with an established analgesic procedure.

Acupuncture therapy consisted of electric stimulation at acupuncture points on the front limbs that have been recommended for the treatment of laminitis or navicular disease (9). The points used for laminitis were similar to points 76, 84 and 86 to 89 (ref. 9, p.215). These points are located caudal to the shoulder joint, caudal to the proximal metacarpal bone on the lateral aspect overlying the lateral palmar nerve, ventral and dorsal to the medial and lateral sesamoid bones, and on the foot. For navicular disease, the points chosen were nos. 14, 20, 23, 24, 27, 28-1 and 29-2 (ref. 9, pp. 202 and 225). These points are located cranial and ventral to the first thoracic vertebra on the brachiocephalicus muscle, at the middle of the second intercostal space at the level of the shoulder joint, dorsal and ventral to the lateral and medial sesamoid bones, and in the navicular fossa. At each session, at least three of the listed points were stimulated.

Points above the carpus were located by palpation. For points below the carpus, the approximate anatomic location was clipped and scrubbed with ether. The probe of an acupuncture point finder (Hibiki-7 Acupuncture Point Finder, Asahi Corp., Japan) was moved over the skin until the point of decreased electric resistance was found (9). The point was marked with indelible ink.

TABLE II. Signalment for Horses with Navicular Disease

	Breed	Sex[a]	Age (years)	Duration of Lameness (months)
Control				
	Quarter Horse	F	10	12
	Quarter Horse	M/C	17	24
	Quarter Horse x Thoroughbred	F	2.5	12
	Quarter Horse	M/C	10	3
	Quarter Horse	F	10	7
Treated				
	Quarter Horse	F	2.5	5
	Quarter Horse	F	4	9
	Quarter Horse	F	10	12
	American Saddle Bred	M/C	14	8
	Quarter Horse	M/C	14	4

[a]F = female, M = male, M/C = castrated male

TABLE III. Grading Scheme for Clinical Assessment of Foreleg Lameness Associated with Laminitis

Grade	Observation
0	Severe lameness — will not move
1	Severe lameness — effort to initiate movement
2	Moderate lameness — effort when moving
3	Moderate lameness — walks camped out
4	Slight lameness — heel-toe gait and stiffness
5	Subtle lameness — heel-toe gait
6	No lameness

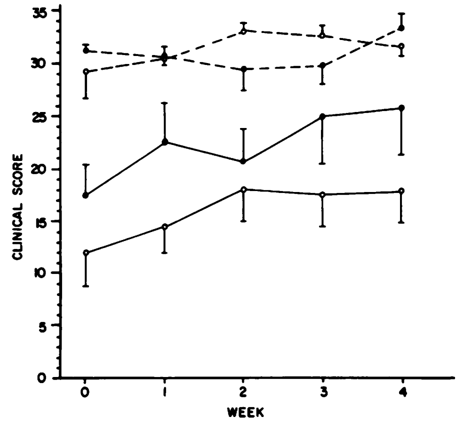

Fig. 1. Combined clinical score (X ± SEM) for control (solid circles) and acupuncture treated (open circles) horses and ponies with laminitis (solid lines) or navicular disease (dashed lines). Combined clinical score is the sum of six individual scores for the walk and circling for both front legs. A sound horse would have a score of 36.

For points above the carpus, stainless steel, sterilized acupuncture needles (Veterinary Acupuncture Needles, 25 gauge, Accu-Tube Corp., Englewood, Colorado) were inserted. For points below the carpus, metal disc surface electrodes (E5GH electrodes, Grass Instrument Co., Quincy, Massachusetts) were used. Conductivity gel (Electrode Conductivity Gel, Teca Corp., Pleasantville, New York) was applied to the electrodes, which were taped on the skin. Needles and disc electrodes were connected to an acupuncture stimulator (71.7 Acupuncture Anesthesia Apparatus made in the People's Republic of China, and obtained on personal loan from Dr. Doris M. Miller, College of Veterinary Medicine, The University of Georgia, Athens, Georgia 30602).

The electric stimulus consisted of a biphasic wave, 0.75 ms duration, at a frequency of 5 hertz for 20 min. The anode of each pair of leads was connected to the distal stimulation site. The intensity was typically increased several times during treatment sessions to maintain minimal muscle contraction around the needles, or until the horse became restless and started to paw the ground. No chemical restraint was used.

A multivariate profile analysis (10) was performed on the three different assessments. The values in the correlation matrices remained similar across time for the combined clinical scores, stride lengths and force plate indices. Therefore, analyses of variance were employed to analyze these measurements, using time as a blocking effect. Data were analyzed to determine whether weeks 1, 2, 3 and 4 differed significantly from week 0 in the four different groups of animals and to determine if there were differences between the control and treatment groups. Missing data points were replaced with a weighted mean. A paired *t*-test was used to compare the mean stride lengths and force plate measurements before and after nerve blocking on week 4, omitting data from animals which were clinically sound at that time. Linear regression was performed to determine the relationship of the stride length measurements and the force plate indices to the clinical evaluation. The significance of the regression was tested by analysis of variance.

RESULTS

Values for the pretreatment stride lengths and force plate indices obtained on two separate days were not significantly different ($p > 0.05$, paired *t*-test) and therefore were averaged to constitute the baseline (week 0) values.

Figure 1 is a graph of the group mean ± SEM values of the combined clinical scores. The graph demonstrates the trend towards gradual improvement in the laminitis groups and the relatively constant lameness in the navicular groups. Comparing baseline to week 4 values in the laminitis control group, two animals became clinically sound (gaining 12 points each), two improved (by 6 and 14 points), and one deteriorated (by 2 points). In the laminitis treated group, three animals improved (by 8 to 13 points), one remained unchanged, and one deteriorated (by 2 points). For the navicular control group, four horses improved (1 to 4 points), and one deteriorated (2 points). For the navicular treated group, three animals improved (2 to 11 points) and two deteriorated (1 and 3 points). These results correspond to approximate response rates (defined here as any increase in the clinical score between weeks 0 and 4) of 80% and 60% for control and treated groups, respectively. At no time during the four week period was the response of the combined clinical score for the treated groups significantly different from controls ($p > 0.05$). All lame animals showed improvement with the nerve block at the end of week 4, but the clinical assessment was not repeated.

The stride length measurements for the left and right front legs are presented in Fig. 2. Statistical analysis of the stride lengths revealed no significant difference in the response of the control vs treatment groups for either disease ($p > 0.05$). The group

TABLE IV. Grading Scheme for Clinical Assessment of Foreleg Lameness Associated with Navicular Disease

Grade	Observation
0	Severe lameness — bearing no weight on limb
1	Severe lameness — observable at the walk
2	Moderate lameness — observable in all gaits
3	Slight lameness — with marked head bobbing
4	Slight lameness — slight head bobbing
5	Subtle lameness — just detectable
6	No lameness

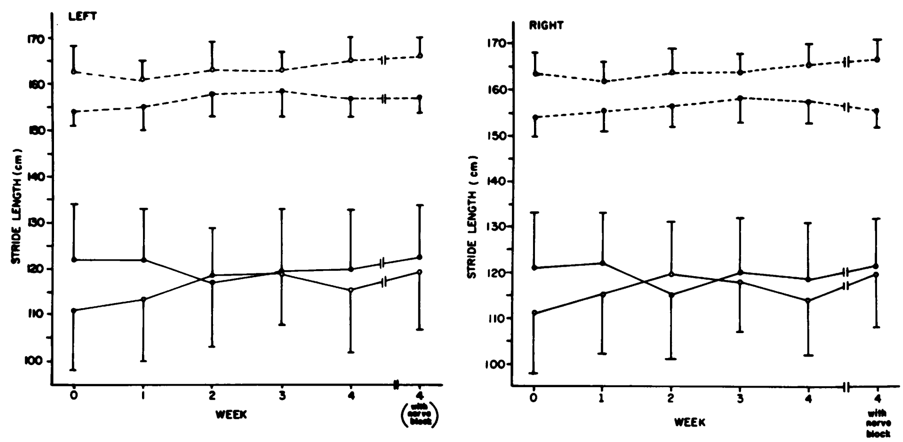

Fig. 2. Stride lengths (X ± SEM) for control (solid circles) and acupuncture treated (open circles) horses and ponies with laminitis (solid lines) or navicular disease (dashed lines).

mean values for weeks 1 to 4 did not change significantly from week 0. The rate at which the stride length increased in the animals with laminitis tended to differ from that of animals with navicular disease, but this was not statistically significant ($p > 0.05$). After nerve blocks on week 4, the stride lengths increased in both laminitis groups (controls, +2 cm on left and +3 cm on right; treated, +4 cm on left and +5 cm on right). Since there were no significant differences between the left and right stride lengths ($p > 0.05$), values for the two sides were combined. After nerve block, stride lengths were significantly greater in the laminitis controls ($p < 0.001$) but not the laminitis treated group ($p > 0.05$). The less severe lamenesses in the navicular groups were associated with minimal changes in stride length after nerve block (controls, no change on left and -2 cm on right; treated, +1 cm on left and right) which were not statistically significant ($p > 0.05$).

The force plate indices are presented in Fig. 3. Results of the statistical analysis over the four week period were the same as for the stride length measurements. With nerve blocks, the mean force plate indices decreased in all four groups; the decrease was significant in the laminitis treated group ($p < 0.05$).

For laminitis cases, there was a significant linear relationship between the combined clinical score and the stride lengths ($r = 0.5$, $p < 0.001$) and the combined clinical score and the force plate index ($r = 0.4$, $p < 0.01$). For navicular disease, a significant linear relationship between the clinical evaluation and the other two measurements did not occur ($p > 0.05$).

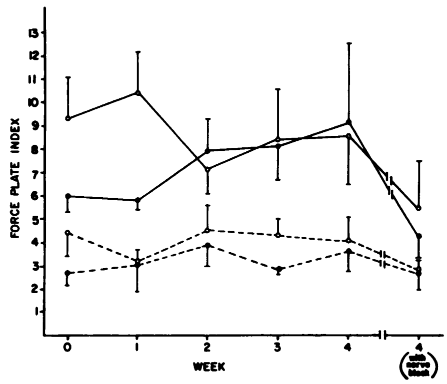

Fig. 3. Force plate indices (X ± SEM) for control (solid circles) and acupuncture treated (open circles) horses and ponies with laminitis (solid lines) or navicular disease (dashed lines). A sound animal would have an index of "0".

DISCUSSION

Clinical studies using acupuncture or transcutaneous nerve stimulation have reported alleviation of chronic pain in humans (2,3,11-15), although the improvement was not always long-lasting (2,16). The veterinary literature suggests that musculoskeletal diseases are responsive to acupuncture (4-6,17,18). Prescribed acupuncture points for treating laminitis and navicular disease have been reported (9). Surveys compiled by veterinarians also imply that acupuncture can be successfully applied to these two diseases (19-22). However, there is a lack of controlled clinical trials.

The importance of controls is underlined by the fact that two out of five laminitis control animals in the present study became clinically sound over the four week period. Factors relating to stall housing, feeding, and/or continued rest may have accounted for the clinical improvement. Spontaneous improvement, even in chronic conditions, needs to be considered before claiming success for any treatment modality, which has been a shortcoming of uncontrolled studies (6,17,18,23). Pretreatment values should not be used as control values in the absence of a separate control group. In this study, there was a response rate of 60% in treated animals. This would have been interpreted as favorable, were it not for the high response rate in the controls.

There are several reasons why this experiment could have failed to demonstrate efficacy of acupuncture. Perhaps the major criticism is the sample size. The small number of animals per group may have obscured a positive effect of acupuncture. Sample size can be calculated on the basis of the anticipated responses of the control and treated groups. In this case, little information was available upon which to base such predictions. Studies in persons often assume response rates of 30% and 70% for placebo and real acupuncture, respectively. With those percentages, using a one-sided test: $\alpha = 0.05$, there would be approximately an 85% chance of detecting this difference if the sample size were 20 patients per group (24). Unfortunately, it was not possible to recruit more animals over a relatively short time period. Alternatively, the acupuncture techniques employed in the present study may have been inappropriate. For example, the frequency of electric stimulation used may have been too low. However, after the four week period, several animals were treated for an additional three or more sessions with higher frequency stimulation (50 hertz) with no change observed. The four week treatment course may have been too short. Other acupuncture points (9) might have been more effective; these need to be evaluated in future controlled studies. Using different points during the four week treatment course may have altered the results. In a recent review of studies using acupuncture for the treatment of pain in humans, it was concluded that the significance of point location is still unclear (25). The combination of surface electrodes and needles in the same animal may have influenced responses. However, one study has reported that electroacupuncture and transcutaneous nerve stimulation produce similar results (26). We treated two horses with needles instead of surface electrodes for an additional week after the study and no change was seen. Interestingly, others have found that consistent electroacupuncture analgesia could not be induced on the head or extremities of horses (27). Whether prior corticosteroid administration can have a long term inhibitory effect on the induction of analgesia by acupuncture in horses remains to be documented. According to their owners and/or trainers, none of the animals in this study had received corticosteroids for at least two weeks before presentation. It has been shown that various formulations of dexamethasone and prednisolone cause decreases in plasma hydrocortisone ranging from 1 to 21 days (28). On the other hand, electroacupuncture therapy has been associated with elevated plasma cortisol concentrations in horses (29).

The force plate system and the stride length measurements provided additional objective data, but the grading scheme used by a clinician experienced in detecting equine lameness was felt to be more sensitive than either of the other two parameters. For laminitis, both stride length and force plate measurements correlated with the clinician's evaluation. For the subtle lamenesses of the horses with navicular disease, neither measurement was a good substitute for clinical judgment.

The "force plate index" was utilized in order to evaluate bilateral front leg lameness which shifted in some of the animals. The patterns of weight redistribution as determined by the force plate system generally paralleled the results reported by Gingerich (30). Weight was transferred from the more lame front leg onto the contralateral hind leg. This was quite consistent in the horses with navicular disease. In a few animals with laminitis, however, weight was sometimes shifted from the more lame front limb to the contralateral front leg.

In conclusion, the specific method of electroacupuncture therapy utilized in the present study was not associated with significant clinical improvement in chronically lame animals when compared to nontreated controls. However, various degrees of clinical improvement occurred in over half the horses and ponies in the control and treatment groups. The relatively high percentage of control animals that improved points out the need for appropriate controls when evaluating the efficacy of acupuncture therapy for conditions such as chronic lameness.

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