

Acupuncture treatment in horses with chronic back pain.  
An evidence based *alternative*?



Report of the fifth year scientific research project of Drs. S.H.H. Walstock

Supervision: Dr. W. Back

Acupuncture treatment for horses with chronic back pain. An evidence based  
*alternative?*

**Index**

Summary .....	3
Samenvatting .....	3
Introduction.....	4
Back pain .....	5
The pathophysiology of pain .....	7
Biomechanics.....	8
Acupuncture .....	9
Review .....	13
EMG .....	15
Conclusion.....	16
References .....	17
Appendix A .....	23
Hypothesis.....	23
Materials and methods .....	23
Horses.....	23
Data collection .....	23
Data analysis.....	24
Ethical review .....	24

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

### **Summary**

In sport horses with back pain, acupuncture is one of the used complementary alternative medicine. (CAM) This report contains an overview on the pathogenesis of back pain and describes the working mechanism of acupuncture. Articles describing the effect of acupuncture on horses with chronic back pain are critically reviewed. A suggestion for a study design is included to evaluate the effect of acupuncture on the muscle activity of the longissimus dorsi muscle.

### **Samenvatting**

Bij sportpaarden met rugpijn, is acupunctuur een van de gebruikte complementaire alternatieve therapieën. (CAM) Dit verslag geeft een overzicht van de pathogenese van rugpijn en het werkingsmechanisme van acupunctuur wordt beschreven. De kwaliteit van artikelen die het effect van acupunctuur bij paarden met chronische rugpijn beschrijven worden kritisch beoordeeld. Er is een onderzoeksvoorstel toegevoegd dat het effect van acupunctuur op de spieractiviteit van de m. longissimus dorsi beoordeelt.

## **Introduction**

Back problems in the horse are often a cause of decreased performance in different kinds of equine sport. Besides problems concerning the bony parts, like in dorsal impingement, there can be damage to the nervous system (neurological disorders) or soft tissue, muscles and ligaments of the thoracolumbar vertebral region. (Jeffcott 1979, Gregory 2004) Making a diagnosis often is not simple, but because of the constant development of diagnostic tools, like radiography, ultrasound, scintigraphy, kinematics and EMG, the knowledge about the possible causes increases continuously. (Denoix 2001b, Peham *et al* 2006) Acupuncture is one of the possible therapies for horses suffering from chronic back pain. (Ridgway 1999, Martin *et al* 1997, Xie *et al* 2005) In certain veterinary and human medicine settings acupuncture is a popular complementary therapy. There are some indications of a positive clinical effect, (Xie *et al* 2001, Martin and Klide 1987), but reviews describe that there has not been found sufficient evidence to accept or reject the effectiveness of acupuncture in both veterinary and human medicine for various problems. (Habacher *et al* 2006, Johnston *et al* 2008, Cherkin *et al* 2003) Prospective, randomized, double blind, clinical trials are necessary to prove if the effect of acupuncture is more than a placebo effect. (Van Sluijs 2000) This study gives an overview of the clinical signs and diagnosis of back problems in the horse. Also the literature on the effectiveness of acupuncture as one of the possible therapies in horses with back pain will be reviewed. Finally a study design is developed to evaluate the influence of acupuncture on the EMG signal in the longissimus dorsi muscle.

## **Back pain**

Back pain in horses is often difficult to diagnose. The clinical signs are aspecific and mostly a decreased performance is the main complaint of the rider/ owner. The anatomical structures from where back pain can originate are very difficult to palpate. This makes the identification of the structures involved very difficult. Because individuals can have a different pain threshold, there can be a variable response to pain. In horses it is believed that temperament plays a role in this. (Jeffcott 1999)

Signs of back pain in horses are: sensitive at palpation, sinking when placing the saddle, when securing the girdle, or when the rider mounts. Not wanting to trot, canter or walk in reverse, refusing to jump. Strongly sweeping the tail or a lameness of one, or both of the hind limbs without a cause or possible diagnosis. (Martin and Klide 1987) Horses express pain by fleeing or evasion, taking an abnormal stance, gait or speed, vocalising or showing signs of aggression during movement or manipulation, restlessness, sweeping the tail and muscle tension and tremors. (Gregory 2004) When back pain becomes chronic, muscular atrophy of the back can become visible. Chronic pain, unlike acute pain, can be present without an inflammation or noticeable tissue damage. Horses with chronic pain can be aggressive or evasive when they can't react in their natural way by fleeing. This is why owners and/ or riders sometimes believe their horse has a behavioural problem and they are not able to identify the underlying painful process. (Ridgway et al 2005) Because the clinical signs often are unclear, excluding other problems is important to get to the diagnosis of back pain.

Micro trauma from chronic overuse because of poor saddle and tack fit and/ or a not optimal riding technique or a wrong training schedule (Haussler 2000) predisposes horses to back pain (Harman 1999). Pain in the back of a horse can originate from various structures. Pain from the muscles produces a dull pain. In various types of tissue, such as connective tissue around muscle bundles, in blood vessel walls and in tendons, afferent nerve endings are found. Some of which can act as pain receptors and respond to noxious

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

stimuli. Deep muscle pain usually covers a relatively large area. Ischemia will cause continuous pain in muscles that does not correlate with the contraction or relaxation of the muscles. Referred pain from abdominal or thoracic organs can project on different parts of the body, such as the back. (Gregory 2004)

Back pain sometimes is a primary process, but in some of the cases the back pain develops because of lameness. 74,3 % of the horses with back problems, also suffer from lameness. And in 32,4% of the lame horses, back problems are also present. (Landman et al 2004) Even subtle hind limb lameness causes changes in movement of the back. The range of motion increases and hyperextension is present in the thoracolumbar back. In the lumbosacral part the range of motion decreased. (Gomez Alvarez *et al* 2007) Impingement of the dorsal spinous processes (kissing spines) is a common finding in horses and can be the cause of clinical signs of back pain. But subclinical cases are not uncommon. (Marks 1999, Johnston 2004) The thoracolumbar part of the spine is predisposed for damage and/ or a painful process. (Wennerstrand 2004)

For the evaluation of the function of the back, there are various diagnostic possibilities. First of all, a good and thorough clinical evaluation is important. This includes a complete lameness examination. Additional techniques can be used to evaluate the function of the back. This includes radiography, ultrasound, EMG, scintigraphy and kinematics. Kinematics is a measuring technique that uses reflective markers on anatomically set positions on the horse. This way measurements can be done on, for example, stride length, flexion, extension, axial rotation and the symmetry of the back in different gaits. It has proved to be a useful tool in evaluating the effectiveness of therapeutic interventions, like chiropractic manipulation. (Gomez Alvarez *et al* 2008, Faber *et al* 2003) It can be used in a study protocol to evaluate the effect of acupuncture treatment on the kinematics of the back in horses with back pain.

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

Different therapeutic interventions are possible for the treatment of back pain. Some are a part of western medicine and others are known as complementary alternative medicine (CAM). In western medicine, non-steroidal anti-inflammatory drugs, local injections with anaesthetics, corticosteroids or saline, physical therapy and swimming are possible treatments. (Roethlisberger Holm 2006) Examples of CAM treatment are acupuncture, osteopathy and chiropractic. (Chan *et al* 2001, Haussler 1999b) To educate and advise the owner/ rider of horses with back pain, riding instructions are important. (Marks 1999) Chiropractic manipulation is one of the possible CAM treatments. Chiropractic manipulation has various effects on the kinematics of the back. Kinematic measurements following treatment show a less extended thoracic back and a greater symmetry of the pelvic motion compared to before treatment. (Gomez Alvarez *et al* 2008)

### **The pathophysiology of pain**

Pain works as a protection mechanism to prevent (further) tissue damage and allows healing of (possible) wounds and damaged tissue. Pain cannot be objectively measured, because it has no unit. Changes in heart rate, blood pressure, plasma cortisol and behaviour can be helpful to study and identify pain. Examples of ways to subdivide pain are acute versus chronic pain, somatic versus visceral pain and physiological versus pathological pain. Physiological pain is the sensation of possible damaging factors like heat, pressure or chemicals. Pathological pain occurs when the tissue is damaged and responds with inflammation. (Robertson 2002) In mammals inflammation is the greatest cause of pain. (Gregory 2004) During an inflammation, sensitisation occurs of the nerve endings that respond to noxious stimuli, like heat, pressure en chemical stimuli. When normal, not painful stimuli are applied, the patient will experience a painful sensation. (Woolf and Mannion 1999) Pressure algometry can be a diagnostic tool in quantifying musculoskeletal pain. Pressure can be applied with a specific measuring device, the algometer, the researcher should gradually increase the pressure and should stop at the moment the horse shows a pain reaction. This can be twitching of the skin, ear movement, sinking, stepping aside, kicking or biting.

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

The maximal applied pressure until pain reaction is used for interpretation. It gives repeatable outcomes when performed by an experienced investigator and can contribute to a clinical examination of the back. It can be useful for the evaluation of the effectiveness of various therapeutic interventions, like acupuncture. (Hausler 2006)

## **Biomechanics**

The movement of the back is produced by a number of factors, the muscle activity from the longissimus dorsi muscle and others, the acceleration from the hind legs, gravity and the influence of the rider. (Peham et al 2006) The longissimus dorsi muscle is one of the three epaxial muscles, which are situated dorsally from the transverse processes of the spinal cord. The longissimus dorsi is the middle one. It runs from the transverse processes of the thoracic and lumbal vertebrae and the dorsal extremity of the ribs to the crista iliaca. (Hausler 1999a) The longissimus dorsi muscle contributes to the support of the weight of the rider and the saddle against dynamic forces. (Licka et al 2004) Bilateral contraction of the epaxial muscles produces extension of the spinal cord and unilateral contraction produces lateral flexion and rotation. (Hausler 1999a, Denoix 2001a, Peham et al 2001) In walk the natural development of the gait is important, because the back moves passively. In trot, the back muscles have an active participation in the movement. Walk and trot are symmetrical gaits, and the movement of the back in these gaits is highly symmetrical. (Jeffcott 1979)

By combining kinematics and EMG, the relationship between the muscle activity and the movement of the back is determined. (Peham 2006) The maximal EMG activity of the back precedes the maximal vertical movement. At the end of every stance phase and during the suspension phase of every stride cycle, the longissimus dorsi muscle provides lumbosacral extension and provides the propulsion force of the hind leg. (Denoix 2001b) The highest muscle activity of the longissimus dorsi muscle during passive movement of the back in stance (flexion and extension) and during active movement at a treadmill in trot is found at T12. (Peham et al 2001, Licka et al 2004)



## Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

Johnston *et al* (2004) have performed a kinematic evaluation of the back in horses without a history of back problems in order to develop a database on kinematics. Older horses have decreased flexion and extension of the thoracolumbar junction in trot. Kinematics can be a useful tool in recognizing horses with back pain because the movement pattern of the back changes in these horses. These horses try to find a way to move in which the pain is minimal. Horses with sore backs have a significantly decreased range of motion for dorsoventral flexion and extension at T13 and T17 at walk and at T17 and L1 at trot compared to horses without back pain. The range of motion at walk at T13 is significantly greater in the horses with back pain. At walk and trot there is no difference in lateral bending between horses with and without back pain. During walk, horses with back pain have a decreased axial rotation of the pelvis. Decreased movement of the back can also be present due to pathological conditions. (Wennerstrand *et al* 2004, Gomez Alvarez 2007) The most significant differences are visible in walk and not in trot.

### **Acupuncture**

The word acupuncture is formed by the combination of the Latin words *acus*, "needle", and *pungere*, "prick". Acupuncture is a part of the Traditional Chinese Medicine (TCM) in which needles are inserted at described points in the skin, called acupuncture points (acupoints). This empirically based form of medicine dates back to 1500 BC. TCM not only uses acupuncture as a therapy, but also herbal medicine, massage, breathing exercises and others. Besides the use of needles, electro-acupuncture, laser acupuncture or acupressure (massaging of acupuncture points) are other forms of acupuncture. The philosophy is based on the Yin-Yang principle, which explains that everything in nature is constantly subject to change. Yin and Yang are each other's opposites but on the other hand they complement each other.

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

<b>Yin</b>	<b>Yang</b>
Dark	Light
Moon	Sun
Night	Day
Feminine	Masculine
Chronic	Acute

Table 1

Diseases can also be divided into Yin or Yang, in which Yin diseases are the chronic conditions in which the pain decreases by applying warmth and movement. Yang diseases are inflammations, which usually show the following signs: redness, swelling, temperature rise and a sharp pain. Yang pain decreases by applying rest and cold. Yin and Yang are parts of the life energy, called Qi or Chi, which is present everywhere, but researchers have not been able to quantify or measure Qi. Qi circulates through channels, called meridians. There are 12 meridians, which are all connected to a certain organ or organ system. Most of the acupuncture points are located on these meridians. (Van der Molen 1999) Since the formation of the International Veterinary Acupuncture Society (IVAS) in 1974, acupuncture has become more popular as a therapy in animals as well.

Trigger points are used in western medicine for making a diagnosis and for the treatment of pathological pain. They can be recognized as painful, hard nodular structures within a muscle or fascia. Sometimes they can be localized subcutaneously or in the periosteum. Trigger points can occur anywhere on the body, but mostly they appear on stable, anatomically described points. (Janssens 1992) There is a correlation between the location of trigger points and the location of acupuncture points. Both types of points are discovered independently in different fields of medicine, eastern versus western. Applying pressure on trigger points can produce pain in the trigger point itself, or referred pain in myofascial or visceral structures.

Acupoints are described in eastern medicine. Both theories are based on the empirical perception that by applying pressure on a painful point on the body, the pain decreases. Physical therapists and others also use this information

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

during therapy. Instead of applying pressure like in trigger point therapy, needles are inserted in these points in acupuncture. (Melzack *et al* 1977).

Acupoints are situated on specific locations of the body. The skin at the acupoints has a decreased resistance for electric power compared to the surrounding skin. Inserting a needle in acupoints will influence the energy in the meridian and in the corresponding organ. The basic of acupuncture therapy is to restore the balance of energy (Qi) in the body. (Van der Molen, 1999, Xie *et al* 2005) Besides the acupoints which are described in the different manuals and atlases, every point on the body can be used as an acupoint. Points that are painful on palpation, so called Ah Shi points, can be stimulated by any form of acupuncture. Insertion of an acupuncture needle causes micro trauma, which produces a local inflammatory reaction (Ridgway 2005) and always has a degree of afferent sensory stimulation. (Skarda *et al* 2002) The use of a twitch in horses is based on the same principle as acupuncture; stimulation of the receptors in the skin of the nose produces analgesia. (Lagerweij *et al* 1984) The effect of the twitch and of acupuncture can be blocked by naloxon, a specific opioid antagonist, (Xie *et al* 2005), which indicates that opioids play a role in the pain transmission. (Veeneklaas 1999, Han 2004) A significant increase of  $\beta$ -endorphins in plasma and cerebrospinal fluid has been found following acupuncture treatment in horses. (Xie *et al* 2001) Electro acupuncture produces a greater  $\beta$ -endorphin release in the cerebrospinal fluid than needle acupuncture. (Skarda *et al* 2002) Besides the  $\beta$ -endorphin release there is another theory on the possible function of acupuncture, the gate control theory. This theory describes the fact that pain in the central nervous system is inhibited by stimulation of sensory receptors (by needle insertion) in the same innervation area. (Veeneklaas 1999, Ammendolia 2008)

In human research there has been found a correlation between stimulation of acupuncture points and the activation and deactivation of certain, specific areas in the brain, compared to stimulation of sham points. (Points that are not described as being acupuncture points, but which are located nearby the used acupuncture points and are innervated by the same spinal segment.)

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

Some brain areas are activated and deactivated by both acupuncture points and sham points. (Yan *et al* 2005, Hsieh *et al* 2001) Stimulation by acupuncture needles at the vertebral level of the pathological process gives better analgesia on the short term, compared to stimulation distal from the pathological process. (Skarda *et al* 2002) In researches on the effect of acupuncture in humans with back pain, positive effect has been described. The largest positive effect has been found when acupuncture is compared to a negative control group or when acupuncture is used as a complementary therapy. There are conflicting results from studies, which compare acupuncture with needling of sham points. Concluding there is not enough evidence to prove that the effect of acupuncture is greater than the effect of needling sham points. (Ammendolia *et al* 2008)

Acupuncture points in horses originate from two different acupuncture backgrounds. One of the systems has taken human acupuncture points as a basis for the equine atlas. The human points were 'translated' to the equine model, using corresponding anatomical landmarks. Western acupuncturists generally use the transpositional atlas in equine acupuncture. (Fleming 2001)

## **Review**

Articles that contain data on the effect of acupuncture as a treatment for horses with back pain are included in this review. Two articles are found with relevant data on the effect of acupuncture in horses with chronic back pain.

Xie *et al* (2005)

Fifteen horses with thoracolumbar pain are randomly assigned in one of the three treatment groups. The effect of acupuncture on the pain relief of horses with back pain is compared with treatment with phenylbutazon and with a control group in which the horses receive 0,9 % NaCl per os.

Group 1 (4 horses) received electroacupuncture every 3 days for 5 treatments. Group 2 (7 horses) received phenylbutazone 2 dd po for 5 days. Group 3 (4 horses) was the control group which received 0,9% NaCl 2dd po for 5 days. The horse owners and trainers were not informed on what treatment their horse had received. Thoracolumbar pain scores (TPS) are evaluated before and on different moments after each treatment. (On day 1, 4, 7, 10 and 13 and 7 and 14 days after the last electroacupuncture treatment) The mean score of 2 TPS investigations was used because of the subjective nature of behaviour. One of the TPS scores was evaluated from videotapings of the examinations. After a wash-out period of 4 weeks, the measurements are repeated, but group 3 is not included in the examinations. The horses in this group were reallocated to one of the other groups. The results show that after 2 treatments there is no significant difference in pain scores between the 3 groups. After treatment 3 until 14 days after the final treatment, the group which received acupuncture treatment has a significant decreased pain score compared to the other groups. Between the NaCl and phenylbutazone group there is no significant difference. The article concludes that the decrease in TPS scores for the acupuncture group occurs after 3 treatments and can last at least 14 days after the fifth treatment.

Critical notes can be made concerning the article; one is the reason for the reallocation is not explained in the article. The second part of the measurements, there is no negative control group included in the study. The

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

duration of treatment in the 3 groups is different. Phenylbutazone and NaCl are administered for 5 days, but the acupuncture therapy covers 15 days (once every 3 days for 5 treatments). It is not clear if the person investigating the TPS scores was blinded to the given treatment.

Martin and Klide (1987)

In this study 15 horses were used which were referred to the university clinic by other veterinarians. All the horses showed signs of chronic back pain, which existed for 2-24 months and didn't improve with previous therapies. Hind limb lameness, poor saddle fit and poor riding technique were ruled out as a cause of the back pain. All horses were treated by injecting 1 ml of saline solution in the same 9 acupoints. The horses were treated once a week for 7 to 12 weeks with an average of 9 treatments. Evaluation of back pain signs was performed by the investigators, rider/ trainer and referring veterinarian. This was done on 3 moments in the study: before, during and after the treatment period. The horses were classified as alleviation of signs, or no change. Only if all 3 evaluators concluded that the horse had a decrease in back pain, the horse was classified as alleviation of signs. If one of the 3 believed there was not sufficient evidence for a decrease in back pain, the horse was classified as no change. The horses were classified as alleviation of signs, when the horse's performance was normal, there were no clinical signs of back pain and the owner/rider thought the horses could perform normally. 13 of the 15 horses were classified as alleviation of signs. 2 horses did not show a decrease of signs of back pain. 12 months after the final treatment, 11 of the 13 horses were still in competition without showing any signs of back pain. The other 2 horses were out of competition because of reasons other than back pain.

The nomenclature of the acupoints used in this study is different from the traditional and transpositional points which are commonly used worldwide. No explanation is given on why different points are used. No control group is included in the study, which makes it impossible to rule out the placebo effect of the treatment. The exact moment of evaluation of back pain signs is not made clear in the report. The method of classification of the horses is not

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

described as well. Because the classification of the horses is not performed by an objective person, the outcome has a high risk of being subjective.

## **EMG**

EMG is a general accepted tool for the examination of the muscle function in horses. Because of the great variance in measurement outcomes, the clinical relevance is limited. (Licka *et al* 2004) With needle EMG, the electrical activity of the motor unit is evaluated. This way a possible pathological process can be detected and the difference between neurological and myogenic disorders can be made. (Wijnberg *et al* 2002) The advantages of surface EMG compared to needle EMG are: it is less invasive and measurements during movement are possible. (Franssen 1995) In pathological conditions, the muscle tension will change the relation of the minimal and maximum EMG activity independent of the muscle mass, the conduction of the skin, the exact location of the electrodes, the EMG measuring device or configuration. (Licka *et al* 2004) In EMG measurements following acupuncture in healthy humans, there has not been found a difference in muscle activity. (Tough 2006) There has been found a decrease in asymmetry (left versus right) of the EMG signal in the back of people after applying acupuncture to the paraspinal muscles. (Tanaka 1998) By injecting hypertonic saline into the back muscles of humans, back pain can be induced. EMG recordings after inducing back pain show an increase of mean EMG signal compared to a control group.

Arendt- Nielsen *et al* 1995 have found there is no correlation between the degree of pain and the changes in EMG signal. Manual therapy has proved to significantly decrease the muscle tone and the total muscle activity, measured by EMG. (Wakeling 2006)

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

## **Conclusion**

A lot of literature on acupuncture in human and veterinary alternative medicine is available, but there is a lack of good quality study designs. Often the patient groups are relatively small; also the blinding of the study is hard to obtain. Negative controls are often not included in studies. Articles have described some of the effects of acupuncture, like endorphin release or improvement of performance. Controversial outcomes are given in articles comparing acupuncture with sham treatment. It is unclear if specific acupuncture points are of greater value than aspecific needling of the painful area. Further studies with larger sample sizes and relevant control groups are necessary to obtain scientific evidence to accept or reject the effectiveness of acupuncture.



## References

Ammendolia, C., Furlan, A.D., Imamura, M., Irvin, E., Tulder, M., van. (2008) Evidence-informed management of chronic low back pain with needle acupuncture. *Spine J.* **8**. 160-172.

Arendt- Nielsen, L., Graven-Nielsen, T., Svarrer, H., Svensson, P. (1995) The influence of low back pain on muscle activity and coordination during gait: a clinical and experimental study. *Pain.* **64**: 231-240.

Chan, W-W., Chen, K-Y., Liu, H., Wu, L-S. Lin, J-H. (2001) Acupuncture for general veterinary practice. *J. Vet. Med. Sci.* **63**: 1057-1062.

Cherkin, D.C., Sherman, K.J., Deyo, R.A., Shekelle, P.G. (2003) A review of the evidence for the effectiveness, safety, and cost of acupuncture, massage therapy, and spinal manipulation for back pain. *Ann. Intern. Med.* **138**: 898-906.

Denoix, J.M.D., Pailloux, J.P. (2001a) Anatomy and basic biomechanical concepts. In: *Physical therapy and massage for the horse*. London: Manson publishing, pp. 19-78.

Denoix, J.M.D., Audigié, F. (2001b) The neck and back. In: Back, W., Clayton, H.M. (eds) *Equine Locomotion*. London: WB Saunders, 167-191.

Faber, M.J., van Weeren, P.R., Schepers, M., Barneveld, A. (2003) Long-term follow-up of manipulative treatment in a horse with back problems. *J. Vet. Med.* **50** 241-245.

Fleming, P. (2001) The location of equine back *Shu* points: Traditional Chinese versus transpositional. In: Schoen, A.M. (ed.) *Veterinary acupuncture, ancient art to modern medicine*. St Louis: CV Mosby Co, pp. 393-431.

Acupuncture treatment for horses with chronic back pain. An evidence based alternative?

Franssen, J.L.M. (1995) Registratie en bewerking van de oppervlakte-EMG. In: *Handboek oppervlakte-elektromyografie*. Utrecht, De Tijdstroom, pp. 117-142.

Gregory, N.G. (2004) Pain. In: *Physiology and behaviour of animal suffering*. Oxford: Blackwell Science, pp. 94-130.

Gomez Alvarez, C.B., Bobbert, M.F., Lamers, L., Johnston, C., Back, W., van Weeren, P.R. (2007) The effect of induced hindlimb lameness on the thoracolumbar kinematics during treadmill locomotion. *Equine vet. J.* **40**: 147-152.

Gomez Alvarez, C.B., L'Ami, J.J., Moffatt, D., Back, W, van Weeren, P.R. (2008) Effect of chiropractic manipulations on the kinematics of back and limbs in horses with clinically diagnosed back problems. *Equine vet. J.* **40**: 153-159.

Habacher, G., Pittler, M.H., Ernst, E. (2006) Effectiveness of acupuncture in veterinary medicine: systematic review. *J. Vet. Intern. Med.* **20**: 480-488.

Harman, J. (1999) Tack and saddle fit. *Vet. Clin. N. Am. Equine Pract.* **15**: 247-261.

Han, J-S. (2004) Acupuncture and endorphins. *Neuroscience letters.* **361**:258-261.

Hsieh, J-C., Tu, C-H., Chen, F-P., Chen, M-C., Yey, T-C., Cheng, H-C., Wu, Y-T., Liu, R-S., Ho, L-T. (2001) Activation of the hypothalamus characterizes the acupuncture stimulation at the analgesic point in human : a positron emission tomography study. *Neuroscience letters.* **307**: 105-108.

Hausler, K.K. (1999a) Anatomy of the thoracolumbar vertebral region. *Vet Clin North Am (Equine Pract)* **15**: 13-26.

Acupuncture treatment for horses with chronic back pain. An evidence based  
*alternative?*

Haussler, K.K. (1999b) Chiropractic evaluation and management. *Vet Clin North Am (Equine Pract)* **15**: 195-209.

Haussler, K.K.(2000) Equine Chiropractic: general principles and clinical applications. *AAEP Proceedings* **46**: 84-93.

Haussler, K.K. (2006) Pressure algometry for the detection of induced back pain in horses: a preliminary study. *Equine vet. J.* **37**: 76-81.

Janssens, L.A.A. (1992) Trigger point therapy. *Problems in Vet Med.* **4**: 117-124.

Jeffcott, L.B., (1979) Back problems in the horse- a look at past, present and future progress. *Equine vet. J.* **11**: 129-136.

Jeffcott, L.B. (1999) Historical perspective and clinical indications. *Vet Clin North Am (Equine Pract)* **15**: 1- 12.

Johnston, C., Roethlisberger Holm, K., Erichsen, C., Eksell, P., Drevemo, S. (2004) Kinematic evaluation of the back in fully functioning riding horses. *Equine vet. J.* **36**: 495-498.

Johnston, B.C., da Costa, B.R., Devereaux, P.J., Akl, E.A. and Busse, J.W. (2008) The use of expertise-based randomized controlled trials to assess spinal manipulation and acupuncture for low back pain A systematic review. *Spine.* **33**: 914-918.

Lagerweij, E., Nelis, P.C., Wiegant, V.M., Ree, J.M. van. (1984) The twitch in horses: a variant of acupuncture. *Science.* **225**: 1172-1174.

Landman, M.A.A.M., de Blaauw, J.A., van Weeren, P.R., Hofland, L.J. (2004) Field study of the prevalence of lameness in horses with back problems. *Vet. Rec.* **155**: 165-168.

Acupuncture treatment for horses with chronic back pain. An evidence based  
*alternative?*

Licka, T.F., Peham, C., Frey, A. (2004) Electromyographic activity of the longissimus dorsi muscles in horses during trotting on a treadmill. *Am. J. Vet. Res.* **65**: 155-158.

Marks, D. (1999) Medical management of back pain. *Vet Clin North Am (Equine Pract)* **15**: 179-194.

Martin, B.B., Klide, A. (1987) Use of acupuncture for the treatment of chronic back pain in horses: stimulation of acupuncture points with saline solution injections. *J. Am. Vet. Med. Assoc.* **190**: 1177-1180.

Martin, B.B., Klide, A., (1997) Diagnosis and treatment of chronic back pain in horses. *AAEP Proceedings.* **43**: 310-311.

Melzack, R., Stillwell, D.M., Fox, E.J. (1977) Trigger points and acupuncture points for pain: correlations and implications. *Pain.* **3**: 3-23.

Molen, C. (1999) *Acupunctuur.* 4<sup>th</sup> ed. Elsevier, De Tijdstroom, Maarssen

Peham, C., Schobesberger, H. (2006) A novel method to estimate the stiffness of the equine back. *J. of Biomechanics.* **39**: 2845-2849.

Peham, C., Frey, A., Licka, T.F., Scheidl, M. (2001) Evaluation of the EMG activity of the long back muscle during induced back movements at stance. *Equine vet. J.* **33** (Suppl.): 165-168.

Ridgway, K., (1999) Acupuncture as a treatment modality for back problems. *Vet Clin North Am (Equine Pract)* **15**: 211-221.

Ridgway, K. (2005) Diagnosis and treatment of equine musculoskeletal pain. The role of the complementary modalities: acupuncture and chiropractic. *AAEP Proceedings* **51**: 403-408.

Acupuncture treatment for horses with chronic back pain. An evidence based alternative?

Roethlisberger Holm, K., Wennerstrand, J., Lagerquist, U., Eksell, P., Johnston, C. (2006) effect of local analgesia on movement of the equine back. *Equine vet. J.* **38**: 65-69.

Robertson, S.A. (2002) What is pain? *J.Am. Vet. Med. Assoc.* **221**: 202-205.

Skarda, R.T., Tejwani, G.A., Muir, W.W. (2002) Cutaneous analgesia, hemodynamic and respiratory effects, and  $\beta$ -endorphin concentration in spinal fluid and plasma of horses after acupuncture and electroacupuncture. *Am. J. Vet. Res.* **64**: 1435-1442.

Sluijs, van F.J., (2000) De pretenties van de (dieren)arts. *Tijdschr Diergeneeskd.* **125**: 153-154.

Tanaka, T.H., Leisman, G., Nishijo, K. (1998) Dynamic electromyographic response following acupuncture: possible influence on synergistic coordination. *Intern. J. Neuroscience.* **95**: 51-61.

Tough, L. (2006) Lack of effect of acupuncture on electromyographic (EMG) activity- a randomized controlled trial in healthy volunteers. *Acupuncture in medicine.* **24**: 55-60.

Veeneklaas, R.J. (1999) Neurofysiologische basis van de acupunctuur. *Diergeneeskundig memorandum.* **46**: 26-36.

Wakeling, J.M., Barnett, K., Price, S., Nankervis, K. (2006) Effects of manipulative therapy on the longissimus dorsi in the equine back. *Equine and Comparative Exercise Physiology.* **3**: 153-160.

Wennerstrand, J., Johnston, C., Roethlisberger Holm, K., Erichsen, C., Eksell, P., Drevemo, S. (2004) Kinematic evaluation of the back in the sport horse with back pain. *Equine vet. J.* **36**: 707-711.

Acupuncture treatment for horses with chronic back pain. An evidence based  
*alternative?*

Wijnberg, I.D., Franssen, H., van der Kolk, J.H., Breukink, H.J. (2002) Quantative motor unit action potential analysis of skeletal muscles in the warmblood horse. *Equine vet. J.* **34**: 556-561.

Woolf, C.J., Mannion, R.J. (1999) Neuropathic pain: aetiology, symptoms, mechanisms, and management. *The Lancet.* **353**: 1959-1964.

Xie, H., Ott, E.A., Colahan, P. (2001) Influence of acupuncture on experimental lameness in horses. *AAEP Proceedings.* **47**: 347-357.

Xie, H., Colahan, P., Ott, E.A., (2005) Evaluation of electroacupuncture treatment of horses with signs of chronic thoracolumbar pain. *J Am Vet Med Assoc.* **227**: 281-286.

Yan, B., Xu, J., Li, K., Liu, H., Shan, B., Tang, X. (2005) Acupoint-specific fMRI patterns in human brain. *Neuroscience letters.* **383**: 236-240.

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

## **Appendix A**

Suggestion for a study design to evaluate the effect of acupuncture on the muscle activity of the longissimus dorsi muscle.

### *Hypothesis*

Acupuncture reduces surface EMG activity in sore equine backs.

### *Materials and methods*

#### **Horses**

Six Dutch warmblood horses (mares, age  $11 \pm 2,7$  years and weight  $566 \pm 51,9$  kg) used in this experiment are situated at the Department of Equine Sciences of Utrecht University. These horses are in daily use for pleasure riding by the veterinary student riders association, but all of them show signs of decreased back function and pain ('sore back'). Horses are randomly assigned to a sham- control group (n=3) or an experimental group (n=3).

#### **Data collection**

The skin of the back is clipped, shaved and cleaned with isopropyl alcohol on the locations of the EMG electrodes. The electrodes are placed bilaterally, 5 cm lateral from the dorsal midline at the 12th and 16th intercostal space. They will not be removed between the two measurements to make sure exactly the same part of the muscle will be measured.

An experienced physical therapist (person A) scores the degree of mobility, the soreness and the muscle tone of the back of each horse using a classification table approved by the NVFD.

Muscle contractions are stimulated by passive movement of the back (person A) as described by Peham *et al.* (2001) and basic surface EMG values of every horse are determined (person B). By pushing a blunt object in the right m. longissimus dorsi between T12 and T16 lateroflexion to the left will be stimulated and EMG bursts can be recorded at the right side, and vice versa. Extension is stimulated by bimanually grabbing both sides of the dorsal midline between T12 and T16, whereas EMG bursts of both left and right side

Acupuncture treatment for horses with chronic back pain. An evidence based *alternative?*

are measured simultaneously. Both lateroflexion movement to the left and to the right, and the extension movements are repeated 5 times to a total of 15 measurements performed in the same order, left / right / extension. A ground electrode is placed at the lateral thorax and is held in place by a girth.

In the horses of the sham control group, 2 needles (0,60 x 25 mm) are placed by person C at points, which are not acupuncture points (sham points) but are located nearby the chosen acupuncture points. In the horses of the experimental group, 2 needles (0,60 x 25 mm) are placed by person C unilateral in the left longissimus muscle, 6 cm lateral from the dorsal midline at the 13th and 17th intercostal space. These needles will stay in situ for 15 minutes. The points chosen are acupuncture points (BL18 and BL20), which are described as having a positive effect on back problems (Flemming 2002). Thirty minutes after inserting the needles, EMG-measurements will be repeated and the experienced physical therapist (person A) will score the degree of mobility, the soreness and the muscle tone of the back of each horse again using a classification table. After one week the measurements will be repeated and the horses will switch groups. The test protocol is double blind: person A who scores back mobility and induces passive movements as well person B who performs sEMG-measurements do not know when person C has given the horses acupuncture or sham treatment.

### **Data analysis**

The amplitude, pulse duration and the area under the curve (AUC) of the 15 EMG-measurements per horse before and after intervention, between left and right side and between the experimental and the sham control group will be statistically compared.

### **Ethical review**

The Animal Experiments Committee of Utrecht University has approved the study protocol.



Acupuncture treatment for horses with chronic back pain. An evidence based alternative?

Dorsal view

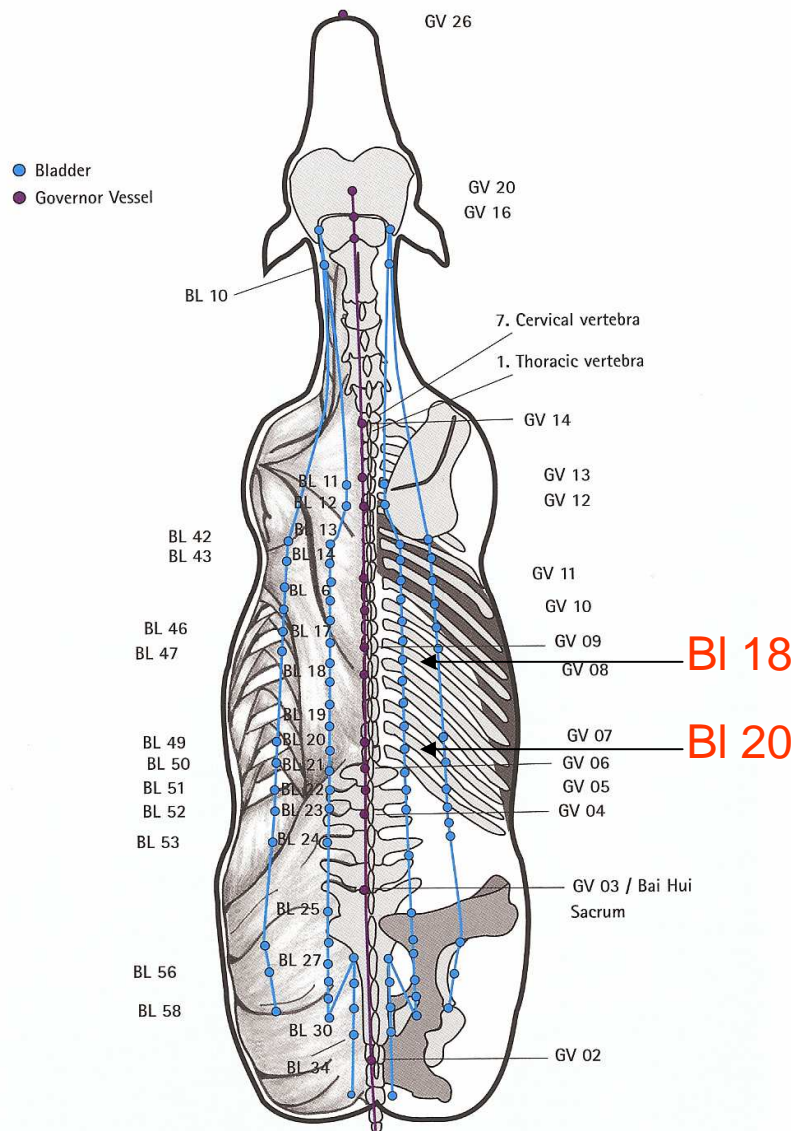


Figure 1  
Adapted from Rosin, P and Füchtenbusch A. (2006) *Laser therapy and acupuncture on horses. Treatment protocols*. Canada. P 118.