

Evaluation of electroacupuncture treatment for thoracolumbar intervertebral disk disease in dogs

Ayne Murata Hayashi, DVM, MSc; Julia Maria Matera, DVM, PhD;
Ana Carolina Brandão de Campos Fonseca Pinto, DVM, PhD

Objective—To evaluate use of electroacupuncture combined with standard Western medical treatment versus Western medical treatment alone for treatment of thoracolumbar intervertebral disk disease in dogs.

Design—Prospective controlled study.

Animals—50 dogs with signs of thoracolumbar intervertebral disk disease.

Procedures—Dogs were randomly allocated to 1 of 2 treatment groups and classified as having grade 1 to 5 neurologic dysfunction. Dogs in group 1 received electroacupuncture stimulation combined with standard Western medical treatment; those in group 2 received only standard Western medical treatment. A numeric score for neurologic function was evaluated at 4 time points to evaluate effects of treatments.

Results—Time (mean \pm SD) to recover ambulation in dogs with grade 3 and 4 dysfunction in group 1 (10.10 \pm 6.49 days) was significantly lower than in group 2 (20.83 \pm 11.99 days). Success (able to walk without assistance) rate for dogs with grade 3 and 4 dysfunction in group 1 (10/10 dogs) was significantly higher than that of similarly affected dogs in group 2 (6/9 dogs). Dogs without deep pain perception (grade 5 dysfunction) had a success (recovery of pain sensation) rate of 3 of 6 and 1 of 8 in groups 1 and 2, respectively, but the difference was not significant. Overall success rate (all dysfunction grades) for group 1 (23/26; 88.5%) was significantly higher than for group 2 (14/24; 58.3%).

Conclusions and Clinical Relevance—Electroacupuncture combined with standard Western medical treatment was effective and resulted in shorter time to recover ambulation and deep pain perception than did use of Western treatment alone in dogs with signs of thoracolumbar intervertebral disk disease. (*J Am Vet Med Assoc* 2007;231:913–918)

Thoracolumbar intervertebral disk disease is a common cause of neurologic dysfunction in dogs.^{1,2} The clinical signs can range from signs of pain or spinal hyperesthesia to pelvic limb paresis or paralysis, with or without deep pain perception and urinary retention.^{3,4} The variability of neurologic dysfunction allows classification as grades 1 to 5, which corresponds to an increasing degree of spinal cord damage.^{5,6} Many dogs will recover from moderate neurologic dysfunction following either medical or surgical treatment.⁴

Acupuncture has been used in treatment for thoracolumbar IVDD in dogs^{7–9} and in spinal cord injuries that have resulted in paralysis and paresis.¹⁰ These reports are typically retrospective analyses, although a prospective clinical controlled study¹¹ in horses with signs of chronic thoracolumbar pain treated with electroacupuncture has been performed. However, few controlled studies about the effect of electroacupuncture for treatment for thoracolumbar IVDD in dogs have been performed. It is difficult to establish whether improvement is attributable to acupuncture or is spontaneous.

From the Department of Surgery, School of Veterinary Medicine, University of São Paulo, São Paulo-SR, Brazil 05508-900.

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Address correspondence to Dr. Hayashi.

ABBREVIATIONS

IVDD	Intervertebral disk disease
FNS	Functional numeric scale

The purpose of the prospective controlled study reported here was to evaluate use of electroacupuncture combined with standard Western medical treatment versus medical treatment alone for thoracolumbar IVDD in dogs. We hypothesized that electroacupuncture would help in the control of pain and improvement of time to recover ambulation and neurologic function.

Materials and Methods

This research was approved by the Bioethic Commission of the School of Veterinary Medicine of University of São Paulo (protocol No. 636/2005). All owners received and signed a consent form prior to the treatment.

Dogs—From March 2005 to February 2006, 61 dogs were evaluated with signs of thoracolumbar IVDD, but only 50 completed the study. Data from the 61 dogs were used to compare FNS scores among dogs determined to have grades 1 to 5 dysfunction when first examined; results permitted certain grades to be combined for further analysis of data from the 50 dogs that completed the study. Dogs were evaluated at

the veterinary hospital of the university and allocated randomly by lot (random selection, they were chosen by chance) into 2 groups; 26 dogs received standard Western medical treatment combined with electroacupuncture (group 1), and 24 received standard Western medical treatment without electroacupuncture (group 2). Clinical, neurologic, and radiographic examinations were performed.

The degree of neurologic dysfunction of each dog was classified as grades 1 to 5, as follows: grade 1 = no neurologic signs except pain associated with IVDD, grade 2 = conscious proprioceptive deficit and ambulatory paraparesis, grade 3 = nonambulatory paraparesis and deep pain perception, grade 4 = nonambulatory paraplegia and deep pain perception with or without urinary dysfunction, and grade 5 = nonambulatory paraplegia and no deep pain perception with or without urinary dysfunction.

Treatment—All dogs received standard Western medical treatment according to clinical signs detected at time of admission to the hospital (day 0). Dogs were treated via oral administration of prednisone (1 mg/kg [0.45 mg/lb], q 24 hours, for 3 days; followed by 0.5 mg/kg [0.23 mg/lb], q 24 hours, for 5 days; and 0.5 mg/kg, every other day, for 5 days).¹² The protocol was modified to be in accordance with the medication prescribed previous to the admission to the hospital. If there were adverse effects (eg, gastrointestinal tract disorder) and suspicion of use of high doses (> 1 mg/kg) of prednisone or other corticosteroids prior to admission, ranitidine (2 mg/kg [0.91 mg/lb], q 12 hours, for 5 or 7 days) was prescribed. If necessary, tramadol¹³ (2 mg/kg, q 8 hours, for 7 days) was prescribed for pain control. Some dogs with grade 1 or 2 dysfunction and chronic clinical signs were already receiving the described protocol, including tramadol.

All owners were advised regarding special care for dogs that had urinary retention or paralysis, to avoid skin lesions and urinary tract infections, and advised to restrict their dog's activity for at least 30 days. The risks of recurrence were also discussed. If neurologic signs worsened, surgical treatment was suggested.

Clinical evaluation and FNS—The time (days) required for a dog's urinary control to improve was recorded by the owner, and the owner or a researcher recorded the time required for a dog to be able to walk without assistance for dogs with grades 3 to 5 dysfunction. Proprioception was evaluated at the hospital. A researcher also evaluated the return of deep pain perception or the presence of spinal reflex walking for dogs with grade 5 dysfunction.¹⁴ To monitor effects of treatments between groups, dogs were evaluated by use of an FNS once per week for at least 3 weeks (days 0, 7, and 14) and then on the last evaluation (day 21 or more for some dogs) by the same researcher that applied electroacupuncture.

The score was determined by evaluation of the ability to stand up (score 0 to 4); movement of pelvic limbs (0 to 4); presence of deep pain perception (0 to 4); urinary control (0 to 4); ability to walk (0 to 4); and movement of the tail (0 to 3; **Appendix**). The total score could range from 0 (worst possible) to 23 (dog without

neurologic signs). The locomotion of each dog was recorded by use of a digital camera to ensure accurate observation and the opportunity to show the improvement or deficiency to the owner. The owner helped to classify movement of the tail (eg, if the dog moved the tail when the owner approached, this was considered voluntary movement).

Success was considered to have occurred when a dog with grade 3, 4, or 5 dysfunction was able to walk without assistance or had return of deep pain perception or a dog with grade 1 or 2 dysfunction had pain control, and improvement in conscious proprioception and ataxia, or both. Pain control was considered to have occurred when the owner observed that the dog had no signs of pain (eg, normal activity and appetite, happy demeanor, and lack of pain-related vocalization) and did not require administration of tramadol.

Acupuncture—Percutaneous electroacupuncture was performed by use of an electroacupuncture device^a and acupuncture needles.^b Selection and determination of the site of the acupuncture points were based on the authors' clinical experience and the veterinary literature.^{15,16,17} Acupuncture points were previously selected by the theory of traditional Chinese medicine and according to the severity of clinical signs, although in general there was little variation.

Acupuncture points, selected on the basis of traditional Chinese medicine, were SI3 (small intestine); BL62 (bladder); BL20; BL23; ST36 (stomach); KI3 (kidney) transfixated with BL60; GV1 (governing vessel); lumbar Bai Hui; in some dogs LI4 (large intestine), instead of SI3; BL25 (instead of BL20, as local point); and GB30 (gallbladder; only for dogs with grade 1 and 2 dysfunction without severe paresis). GV1, instead of GB30, was used in dogs with severe paresis or paralysis or urinary retention.

Pairs of acupuncture points on the same side of the body were connected with an electrode to form a set, which was then subjected to a current at a frequency of 3 Hz alternated with 100 Hz for 3 seconds each, over a period of 20 minutes. Acupuncture points BL20 or BL25 and BL23 were one of the sets; lumbar Bai Hui and GV1 or GB30 (right side) were another set; and ST36 and KI3 transfixated to BL60 (both sides) were the other sets, respectively. Electroacupuncture stimulation was performed in all sets at the same time. The other points were only stimulated by insertion of the needles. Dogs received electroacupuncture treatment once per week for at least 3 applications. Dogs without deep pain perception received electroacupuncture treatment twice per week for 2 weeks, followed by once per week for at least 2 weeks.

Statistical analysis—The FNS scores obtained at each of the 4 time points were compared between groups with the nonparametric Mann-Whitney test because the values were not normally distributed. Within each group, multiple comparisons of FNS scores among the 4 time points were analyzed with the nonparametric Friedman test; if significant ($P < 0.05$) differences were detected, the nonparametric Wilcoxon test was performed for pairwise comparisons. The Friedman test was used because the values were qualitative and

ordinal and more than 2 variables were compared simultaneously. Duration of clinical signs before entering the study was compared between groups with the nonparametric Mann-Whitney test. The time to recover ambulation in dogs with grade 3 or 4 dysfunction was analyzed with the parametric Student *t* test for comparison between groups. For grade 5 dysfunction dogs, the time to recover ambulation was submitted only for descriptive statistical analysis because of the small number of dogs that recovered ambulation. Success rates were analyzed with the 2-proportions test. Values of $P < 0.05$ were considered significant.

Results

Clinical data—Group 1 consisted of 26 dogs (13 males and 13 females) that included 21 Dachshunds, 1 Cocker Spaniel, 1 Springer Spaniel, 2 Poodles, and 1 crossbred. Mean \pm SD age was 6.13 ± 2.2 years, weight was 8.52 ± 3.27 kg [18.74 ± 7.19 lb], and duration of clinical signs before entering the study was 21.7 ± 17.7 days. Two dogs had dysfunction grade 1, 8 had grade 2, 3 had grade 3, 7 had grade 4, and 6 had grade 5.

Group 2 consisted of 24 dogs (14 males and 10 females) and included 16 Dachshunds, 4 Cocker Spaniels, 3 Poodles, and 1 Pekingese. Mean \pm SD age was 4.79 ± 1.61 years, weight was 9.16 ± 3.92 kg (20.15 ± 8.62 lb), and duration of clinical signs before entering the study was 15.42 ± 24.03 days. One dog had grade 1 dysfunction, 6 had grade 2, 1 had grade 3, 8 had grade 4, and 8 had grade 5. Duration of clinical signs in group 1 was significantly ($P = 0.037$) greater than that of group 2.

Evaluation of FNS scores—Analysis of the median FNS scores at time of the first hospital evaluation in all 61 dogs revealed similar values of dogs with grades 1 and 2 (FNS score, 21 and 20, respectively) and grades 3 and 4 (FNS score, 11 and 9, respectively). Dogs with grade 5 dysfunction had a median FNS score of 2. On the basis of these results, further analysis was performed by combination of data from dogs with grades 1 and 2 dysfunction together, dogs with grades 3 and 4 dysfunction together, and dogs with grade 5 dysfunction alone. For these latter analyses, only data from the 50 dogs that completed the study were used.

Duration of clinical signs before entering the study—Mean \pm SD duration in group 1 dogs with grades 1 and 2 dysfunction (29.3 ± 21.88 days; range, 5 to 60 days) was significantly ($P = 0.016$) greater than in group 2 dogs with grades 1 and 2 dysfunction (7.57 ± 6.08 days; range, 3 to 21 days). For dogs with grades 3 and 4 dysfunction, duration in group 1 (15.8 ± 10.0 days; range, 1 to 32 days) did not differ significantly ($P = 0.346$) from that in group 2 (22.2 ± 38.3 days; range, 1 to 120 days). For dogs with grade 5 dysfunction, mean duration in group 1 (19.1 ± 18.2 days; range, 4 to 52 days) also did not differ significantly ($P = 0.953$) from that in group 2 (14.6 ± 8.2 days; range, 4 to 30 days).

Recovery of ambulation—For dogs with grades 3 and 4 dysfunction, mean \pm SD time to recover ambulation without assistance, even if intermittent, in group 1 was 10.10 ± 6.49 days (range, 1 to 20 days) and was significantly ($P = 0.0341$) less than that of group 2 ($20.83 \pm$

11.99 days; range, 5 to 40 days). For dogs with grade 5 dysfunction, mean \pm SD time to recover ambulation without assistance and with presence of deep pain perception in group 1 (3/6 dogs) was 14.66 ± 6.5 days (range, 8 to 21 days) and in group 2 (1/8 dogs) was 18 days.

FNS scores—For dogs with grades 1 and 2 dysfunction, FNS scores did not differ between groups 1 and 2 at each time point. On day 0 and at the last evaluation, FNS scores were similar between groups 1 and 2 regarding dogs with grades 3 and 4 dysfunction. On days 7 and 14, group 1 dogs had significantly higher FNS scores than did group 2 dogs. Within both groups, FNS scores were significantly ($P = 0.001$) higher at each successive time point. For dogs with grades 3 and 4 dysfunction in group 1, FNS scores were significantly higher at each successive time point. For dogs with grades 3 and 4 dysfunction in group 2, differences in FNS scores between paired time points were significant except day 7 versus day 14 (Table 1). For dogs with grade 5 dysfunction in group 1, FNS scores were significantly ($P = 0.001$) different (ie, progressively higher) among all 4 time points. For similar dogs in group 2, FNS scores did not differ significantly ($P = 0.06$) among any time points (Table 2). For dogs with all grades of dysfunction in groups 1 and 2, FNS scores were progressively higher and significantly ($P = 0.001$) different among all time points. The FNS in group 1 was significantly higher than that in group 2 at the final evaluation (Table 3).

Success rate—For dogs with all grades of dysfunction combined, group 1 success rate (88.5% [23/26]), was significantly ($P = 0.015$) higher than that of group 2 (58.3% [14/24]). All dogs with grades 1 and 2 dysfunction in both groups achieved success with regard

Table 1—Functional neurologic scores (median [range]) obtained at various times in dogs with grades 3 and 4 neurologic dysfunction from IVDD that were treated via standard Western medical treatment with (group 1) or without (group 2) electroacupuncture.

Time point (d)	Group 1 (n = 10)	Group 2 (n = 9)	P value
0	10.50 (6–14) ^{a,A}	8 (4–12) ^{a,A}	0.109
7	14 (8–21) ^{a,B}	10 (8–21) ^{b,B}	0.039
14	19.25 (16–21) ^{a,C}	13 (8–21) ^{b,B}	0.020
Last	22 (18.5–22) ^{a,D}	21 (13–23) ^{a,C}	0.160

Time point 0 = Time of first evaluation. Last = Time of last evaluation.

^{a,b}Within a row, values with different superscript letters are significantly ($P < 0.05$) different. ^{A–D}Within a column, values with different superscript letters are significantly ($P < 0.05$) different.

Table 2—Functional neurologic scores (median [range]) obtained at various times in dogs with grade 5 neurologic dysfunction from IVDD that were treated via standard Western medical treatment with (group 1) or without (group 2) electroacupuncture.

Time point (d)	Group 1 (n = 6)	Group 2 (n = 8)	P value
0	4.5 (1–8) ^{a,A}	2.25 (0–4) ^{a,A}	$P = 0.398$
7	6.75 (1–14) ^{a,B}	3 (1–11) ^{a,A}	$P = 0.300$
14	9.25 (1–20) ^{a,C}	3.25 (1–15) ^{a,A}	$P = 0.195$
Last	18.25 (12–22) ^{a,D}	3.5 (1–21) ^{b,A}	$P = 0.010$

See Table 1 for key.

Table 3—Functional neurologic scores (median [range]) obtained at various times in dogs with all grades (1 to 5) of neurologic dysfunction from IVDD that were treated via standard Western medical treatment with (group 1) or without (group 2) electroacupuncture.

Time point (d)	Group 1 (n = 26)	Group 2 (n = 24)	P value
0	11.5 (1–22) ^{a,A}	8.5 (0–21) ^{a,A}	<i>P</i> = 0.166
7	18 (1–23) ^{a,B}	10 (1–23) ^{a,B}	<i>P</i> = 0.069
14	20 (1–23) ^{a,C}	13 (1–23) ^{a,C}	<i>P</i> = 0.080
Last	22 (12–23) ^{a,D}	21 (1–23) ^{b,D}	<i>P</i> = 0.007

See Table 1 for key.

to response to treatment. For dogs with grades 3 and 4 dysfunction, group 1 success rate (10/10 dogs) was significantly (*P* = 0.047) higher than that of group 2 (6/9 dogs). The 3 dogs of group 2 that did not recover ambulation within 3 weeks were treated via decompressive surgery. For dogs with grade 5 dysfunction, success rate in group 1 (3/6 dogs) was not significantly different (*P* = 0.124) from that of group 2 (1/8 dogs). Two dogs in group 1 that did not recover deep pain perception did have spinal reflex walking, although this was not considered a successful outcome.

Mean ± SD time of final evaluation (last visit) was 25.9 ± 6.6 days and 27 ± 10.2 days for groups 1 and 2, respectively, in dogs with grades 1 and 2 dysfunction. Mean ± SD time of final evaluation (last visit) was 39.2 ± 18.1 days and 39.6 ± 19.4 days for groups 1 and 2, respectively, in dogs with grades 3 and 4 dysfunction. Mean ± SD time of final evaluation (last visit) was 56.1 ± 29.1 days and 30.6 ± 11.7 days for groups 1 and 2, respectively, in dogs with grade 5 dysfunction.

Dogs with grades 3 and 4 dysfunction in group 1 received a mean ± SD of 2.2 ± 0.95 electroacupuncture sessions before recovering the ability to ambulate and 7.1 ± 3.57 sessions overall. Dogs with grade 5 dysfunction in group 1 received 5 ± 2.65 sessions before recovering the ability to ambulate (n = 3 dogs) and 10.66 ± 4.36 sessions overall (6).

Urinary control, proprioception, and ambulation ability were analyzed via levels of recovery. In group 1, partial to total urinary control was achieved in 8 of 10 dogs, partial to total recovery of proprioception in 24 of 26 (92.30%) dogs, and partial to total recovery of ambulation in 25 of 26 (96.14%) dogs, including 2 dogs that had spinal reflex walking. In contrast, in group 2, partial to total urinary control was achieved in 6 of 12 dogs, partial to total recovery of proprioception in 13 of 24 (54.16%) dogs, and partial to total recovery of ambulation in 14 of 24 (58.33%) dogs. Recovery of proprioception and ambulation in group 1 were significantly higher than group 2, respectively (*P* = 0.0032 and *P* = 0.0016).

Discussion

A variety of neurologic signs were observed in the present study, which can result in difficulties for comparison among treatment groups. The use of FNS scores made comparisons more meaningful. In addition, the time required for recovery of ambulation represented a less subjective variable than others and was therefore considered a reliable estimate of efficacy of treatment.¹⁸

Mean time required for recovery of ambulation in dogs with deep pain perception that received surgical treatment has been reported as 10.8 days,¹⁸ 12.9 days,² and 10.6 days.⁶ In the present study, a similar mean time of 10.10 days was obtained for dogs with grades 3 and 4 dysfunction that received electroacupuncture plus standard Western medical treatment, which was 50% of the time of 20.83 days in the dogs treated only with standard Western medical treatment and less than that in another report⁷ of the use of acupuncture (17.5 days). In that study, recovery of ambulation in 19 dogs with deep pain perception was achieved in 16 dogs after a mean of 4.8 acupuncture sessions. In the present study, recovery of ambulation in group 1 dogs was achieved in a mean of 2.2 electroacupuncture sessions, although there was a smaller number of dogs (n = 10).

Padilha and Selmi¹⁹ observed a mean time of 20.6 days for recovery of ambulation in dogs with paraplegia and deep pain perception that were treated by use of fenestration of the intervertebral disk. This result was similar to results in group 2 of the present study, in which dogs with grades 3 and 4 dysfunction treated with standard Western medical treatment alone achieved recover of ambulation in 20.83 days.

The FNS was useful for evaluation of the efficacy of treatment of thoracolumbar IVDD in dogs with grades 3 to 5 dysfunction. However, for grades 1 and 2, evaluation should be based on pain control or improvement in proprioception or ataxia because the neurologic dysfunction of such dogs was not severe enough to result in significant changes in the FNS score. Results of other studies^{7,8} in dogs with grade 1 and 2 dysfunction treated with acupuncture were similar to the present study, in which all such dogs achieved successful recovery.

Although there was no significant difference between groups in success rate of dogs with grade 5 dysfunction, group 1 dogs had more neurologic improvement in the last visit. However, the duration of final evaluation in group 1 dogs was longer than in group 2 dogs, and this could have influenced the results for dogs with grade 5 dysfunction. The loss of deep pain perception represented a profound lesion in the spinal cord, which resulted in slow or no recovery.

If small groups of axons survive the injury, they could promote neural input to higher centers. This fact explains how some dogs, even without recovery of deep pain perception, could achieve spinal reflex walking and voluntary tail movement,⁴ as observed in 2 dogs in the present study. Janssens⁷ reported a mean of 76 days for recovery of ambulation in dogs with grade 5 dysfunction that were treated with acupuncture. In the present study, recovery of ambulation of dogs with grade 5 dysfunction was achieved in a shorter time.

Acupuncture can induce improvement in neurologic function in dogs with severe spinal cord injury.^{7,8} A point of controversy is the use of long-term corticosteroid therapy and its adverse effects in neurologic recovery in humans when combined with acupuncture.⁸ Dogs in both groups in the present study received previous or concomitant treatment with corticosteroids. Nevertheless, these dogs had important improvements in neurologic function. We believe that electroacupuncture could be an option before surgical treatment, even

in dogs with grades 1 and 2 dysfunction. Even dogs with chronic clinical signs that were nonresponsive to previously administered medication had improvement after electroacupuncture and standard medical treatment. The beneficial effects of the combined treatment have also been found in an experimental study²⁰ of spinal cord injury in dogs. In addition, better recovery in urinary control, conscious proprioception, and ambulation was achieved by use of standard Western medical treatment plus electroacupuncture, compared with standard treatment alone.

The physiologic changes that occur after acupuncture point stimulation are the basis of this treatment.²¹ The purpose of acupuncture is to rectify an electrical impairment. Acupuncture reduces the electrical resistance and enhances electrical activity of injured tissues.¹⁰ Therefore, acupuncture promotes healing and axonal regrowth.²² An experimental study²³ has confirmed that acupuncture promotes nerve regeneration in rabbits with sciatic nerve injury.

Acupuncture causes sensorial stimulation that promotes release of local or distant neuropeptides via the central and peripheral nervous systems.^{24,25} Because certain neuropeptides are important not only for healing of the initial ischemic lesion, but also for the regeneration process, the use of acupuncture in dogs with IVDD seems appropriate, although the exact mechanism of action of acupuncture in these cases has not been elucidated. Calcitonin gene-related peptide is released by use of acupuncture and is associated with tissue regeneration.²⁴ Acupuncture is also associated with neuroendocrine modulation via release of several hormones,^{26,27} which could explain the positive results associated with its use. For example, thyrotropin-releasing hormone is associated with neurotrophic effects, influences plasticity and facilitation of motor neuron firing,²⁸ and is released by electrical stimulation at a frequency as low as 0.5 and 3.0 Hz,²⁹ and possibly it can be reached by electroacupuncture. Electroacupuncture has been associated with an increase of mRNA expression for nerve growth factor in injured nerves of rats at an early stage between the second and fourth week of the initial lesion, compared with a control group.³⁰

The electrical frequency of electroacupuncture (3 and 100 Hz) used in the present study was adapted from a report by Han.³¹ Use of the combined frequencies of 2 and 100 Hz causes release of all 4 opioid peptides (dynorphin A, β -endorphin, endomorphin, and enkephalins), resulting in a maximal therapeutic effect.³¹ However, the main goal of acupuncture and traditional Chinese medicine is to restore homeostasis by use of an individual's physiologic mechanisms. Via acupuncture, pathologic or physiologic phenomena can be balanced, reducing or increasing an organic function.

Several acupuncture points are described for pelvic limb disorders. For thoracolumbar IVDD, the points may include a local point along the bladder channel, BL17 to BL28. Possible distal points include BL40, BL60, ST36, and GB34, which stimulate afferent nerve fibers to the level of high centers of the CNS and of the affected spinal cord segment. Other acupuncture points that can be used are KI3, KI6, SP4, and SP6.^{7,8} Several authors also describe the use of GB30.^{7,8,16,17,20}

The weakness of pelvic limbs after disk prolapse or rupture seems to chiefly involve the bladder channel. The gall bladder and stomach channels appear secondarily involved. The goal is to restore normal Qi flow down the bladder channel into the limb.¹⁶ Additional studies are required to determine whether different acupuncture points than used in our study can induce better results.

- a. Electroacupuncture device model DS 100 CB, Sikuro, São Paulo, Brazil.
- b. Acupuncture needle (0.25 × 25 mm), Cloud and Dragon, Wujiang, China.

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Appendix

Criteria for scores in an FNS used for evaluation of neurologic function in dogs.

Ability to stand

- 0 = Cannot stand even with assistance
- 1 = Can stand and maintain standing, with assistance
- 2 = Can stand and maintain standing, with assistance, and stand alone for 2 s
- 3 = Can stand and maintain standing, with assistance, and stand alone for > 2 s
- 4 = Can stand without assistance

Movement of pelvic limbs

- 0 = Lack of movement
- 1 = Movement of 1 pelvic limb and nonambulatory
- 2 = Movement of both pelvic limbs and nonambulatory
- 3 = Movement of both pelvic limbs and ambulatory, with weight bearing on 1 or both limbs without assistance, with ataxia
- 4 = Movement of both pelvic limbs and ambulatory, with normal weight bearing and without falling

Deep pain perception

- 0 = Lack of deep pain perception
- 1 = Questionable deep pain perception and need to search in several digits or tail, detectable in 1 of the structures with doubtful response to stimuli
- 2 = Isolated deep pain perception in 1 digit or tail and dog looks toward stimulated structure but does not vocalize
- 3 = Deep pain perception, and dog appears to be more uncomfortable when stimulus applied
- 4 = Unquestionable deep pain perception

Urinary control

- 0 = Lack of urinary control (constant urinary retention or incontinence)
- 1 = Almost constant urinary retention or incontinence
- 2 = Urinary retention or incontinence is intermittent or occurs when the dog is manipulated; manual expression of bladder is required.
- 3 = Intermittent urinary control and lack of incontinence
- 4 = Complete urinary control

Ability to walk

- 0 = Lack of motor function or ambulation
- 1 = Ambulation only if dog supported in the abdominal or inguinal region
- 2 = Ambulation without support, with intermittent ataxia
- 3 = Ambulation without support, with rare ataxia or ataxia only over smooth or slippery ground
- 4 = Normal ambulation

Movement of the tail

- 0 = Lack of voluntary tail movement
- 1 = Nonvoluntary tail movement
- 2 = Intermittent voluntary tail movement
- 3 = Normal tail movement